OCTOBER 1960

Precision Metal Molding

INCLUDING DIE CASTINGS MAGAZINE

Special to PMM: American Motors Reports on the Die Cast Engine Block

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

PMM

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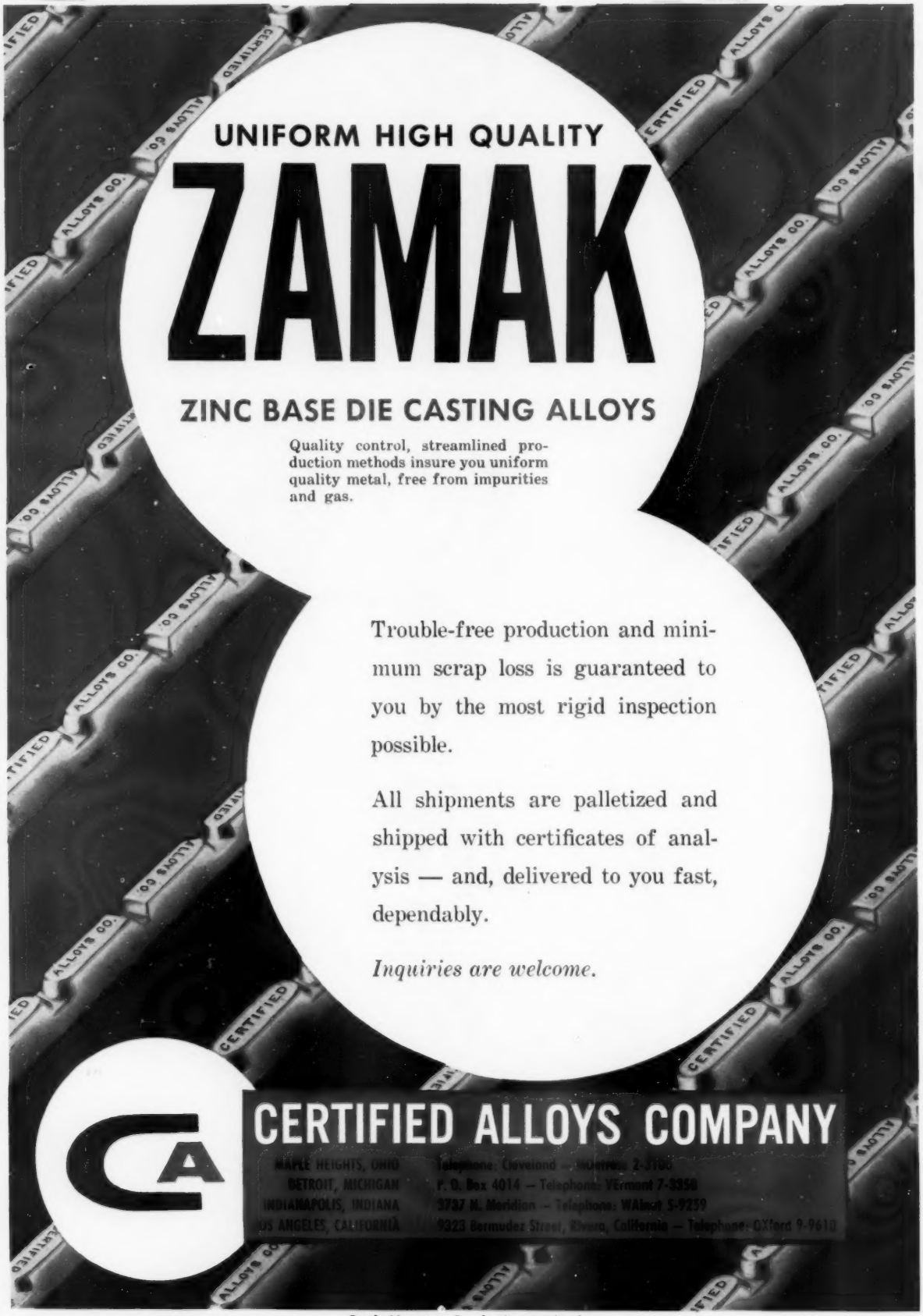
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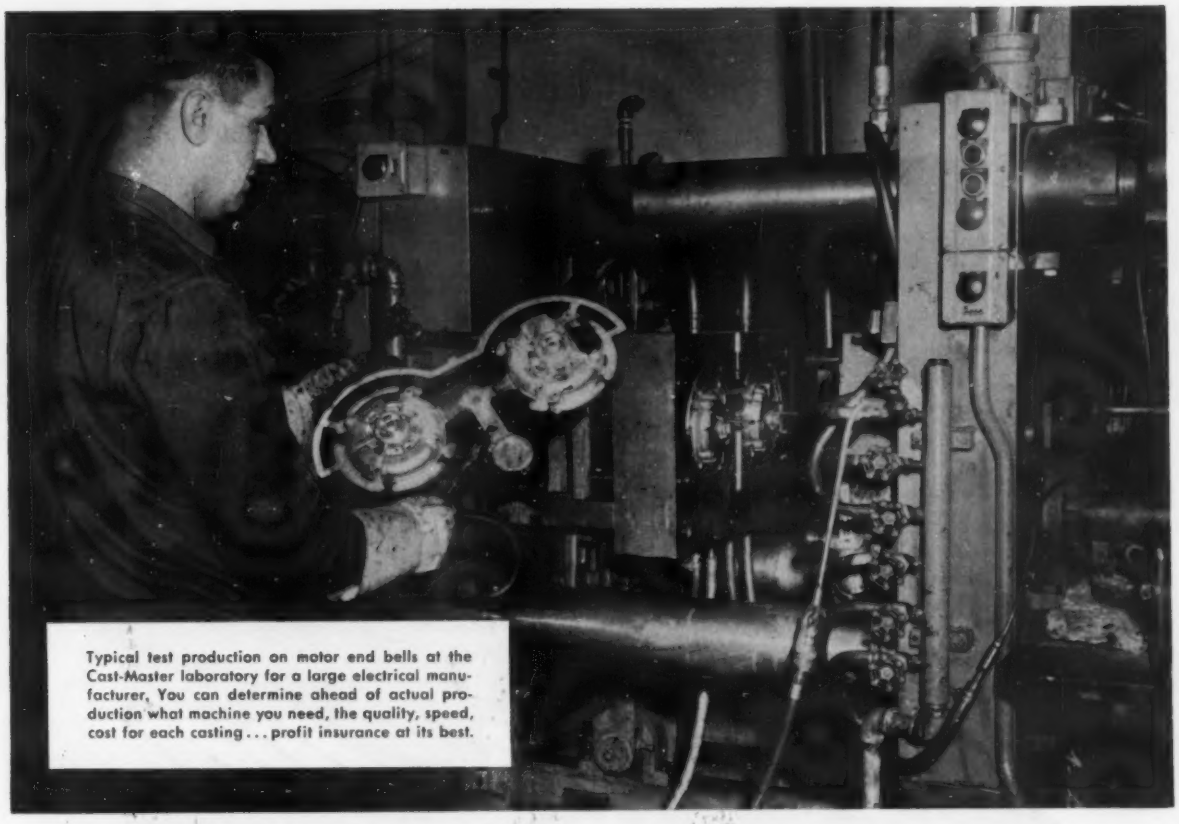

Typical test production on motor end bells at the Cast-Master laboratory for a large electrical manufacturer, You can determine ahead of actual production what machine you need, the quality, speed, cost for each casting . . . profit insurance at its best.

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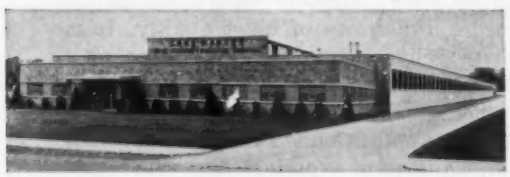

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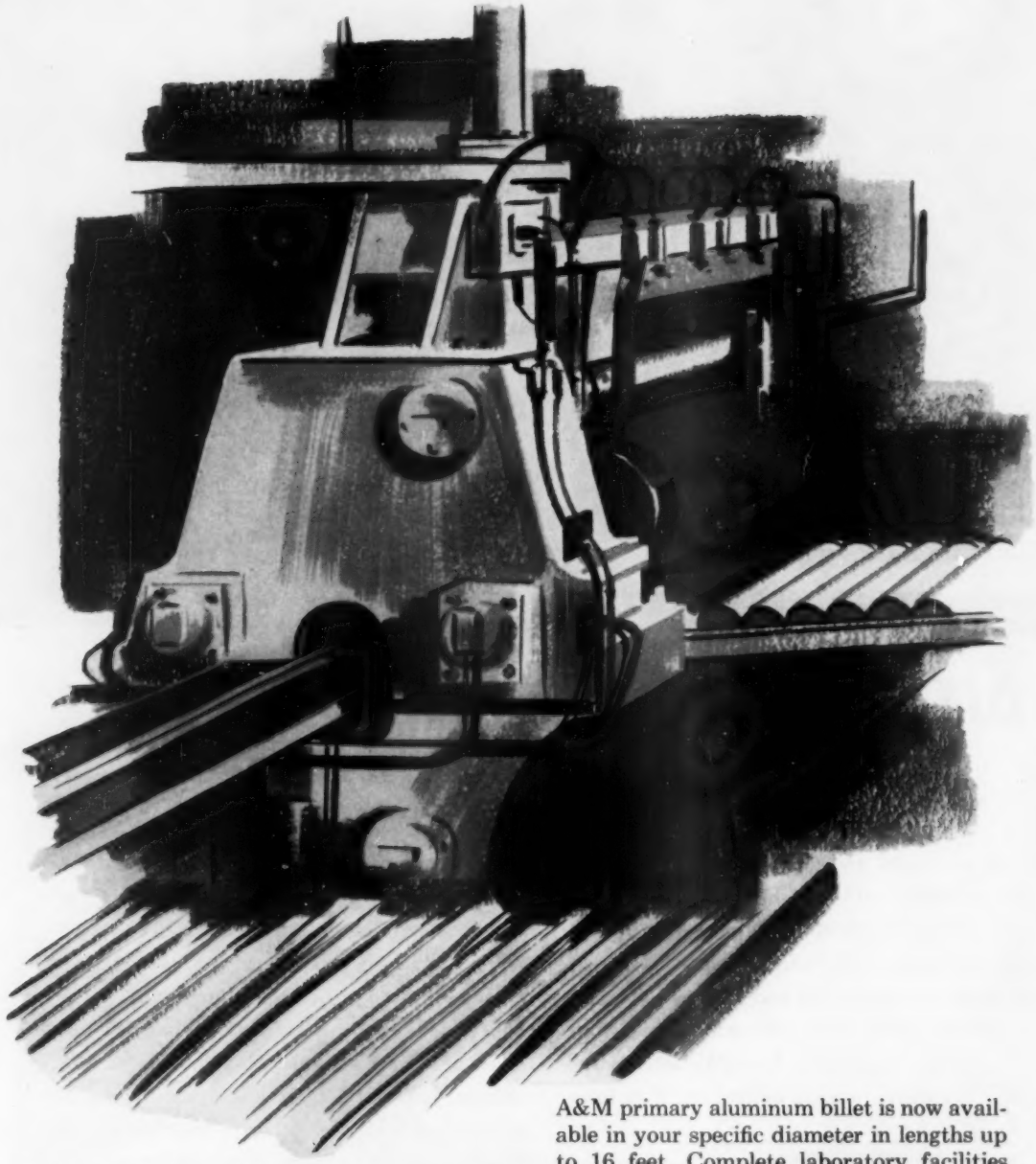

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Here is a method of measuring permeability of investments at pouring temperature.

34 **AMERICAN MOTORS REPORTS ON THE DIE CAST CYLINDER BLOCK**

Over ten years of research and development work have gone into the development of the first practical, die cast cylinder block. This project has been kept alive by both American Motors and by Doehler-Jarvis. As a result, the 1961 Rambler Classic 6 will have the first die cast block. More developments are coming and both the motor company and the die caster confidently predict an all die cast engine in the near future.

THIS MONTH'S COVER

A tremendous variety of extruded shapes are available from stock. The cover shows Harry Pritchard (right) and Vincent Markovich selecting a customer order from the stock at Superior Industries, Youngstown, Ohio

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By using both permanent mold castings and aluminum extrusions the the appearance of barber chairs has been enhanced.

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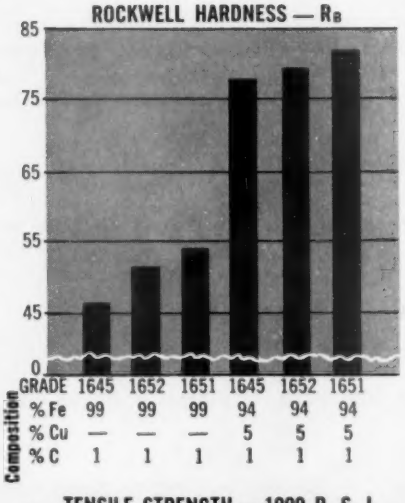

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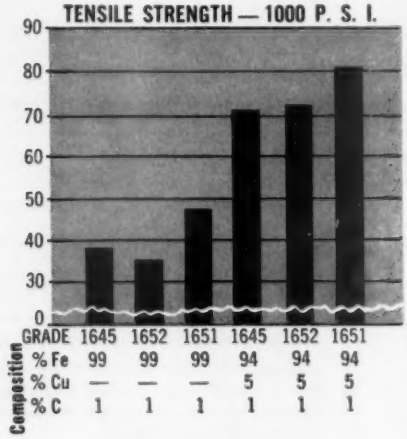

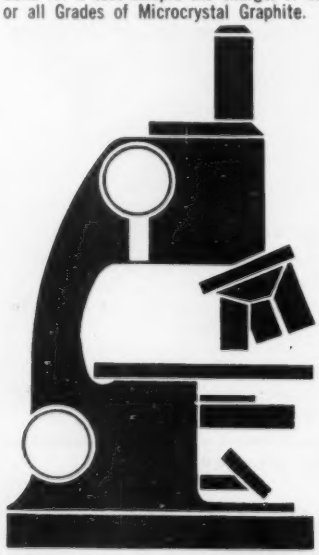

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SUBSCRIPTIONS in U.S. and possessions: $7, 1 year; $12, 2 years. Canada: $8 per year. Foreign: $10 per year, payable in advance in U.S. funds. U.K.: £ 3.5.0 per year payable in Sterling to London office. Single copies, when available: 1 to 10 — $1.00 each; 11 to 25 85¢ each; over 25 75¢ each.

Out of print copies of PRECISION METAL MOLDING are available in complete volumes as positive microfilm copies from University Microfilms, 313 N. First St., Ann Arbor, Mich.

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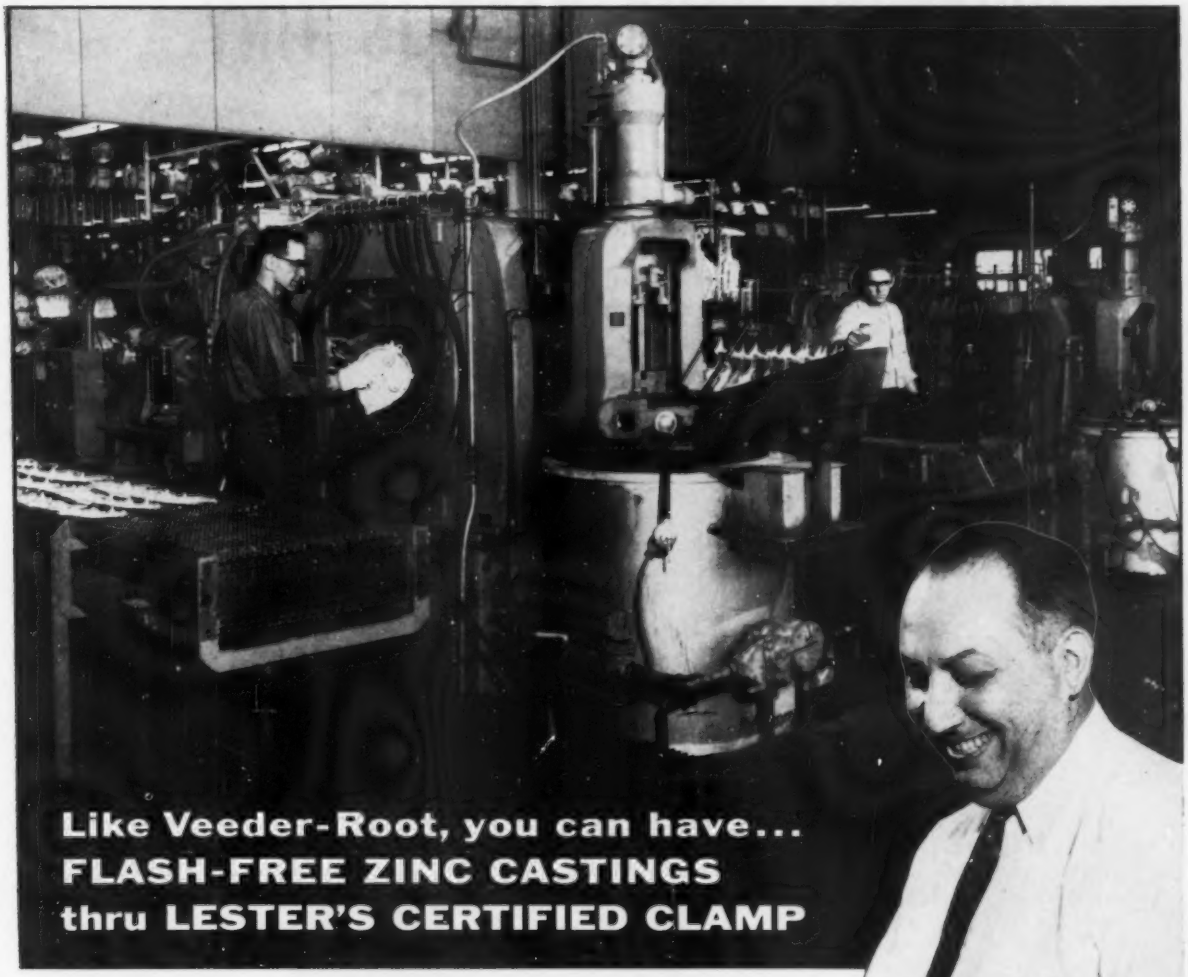

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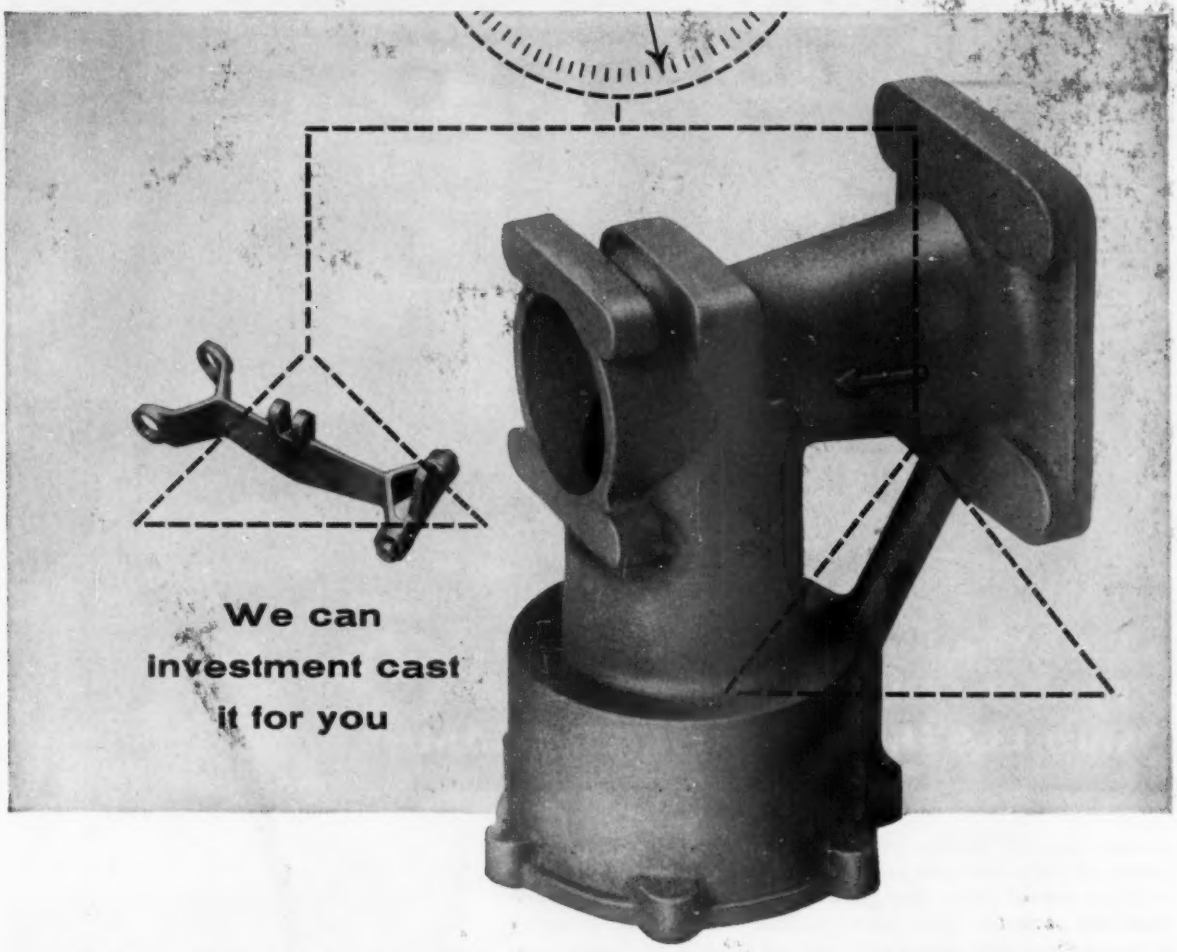

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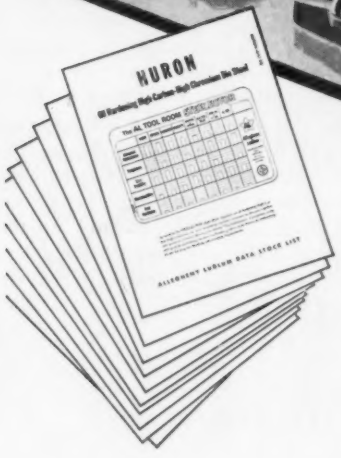

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CASTING ABOUT

& processes involving precision metal molding
technical news of applications

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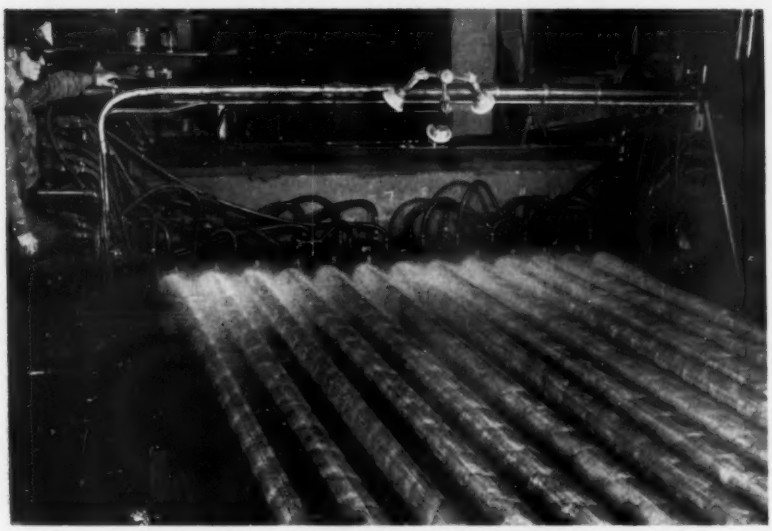

DIRECT CASTING aluminum extrusion billets in a horizontal unit.

Reynolds Metals Co. in their Massena, N.Y. reduction works uses a continuous billet caster which casts aluminum billets horizontally instead of vertically as do most other direct chill, continuous casting machines.

While this system requires a much greater floor space, it has a number of outstanding advantages over vertical units. No pit is required to receive the logs as they are cast. The length of a single log is practically unlimited. Logs can be cut to length while the casting machine is in operation so that the limiting factor is molten metal supply. Different diameter logs can be cast simultaneously and each properly chilled.

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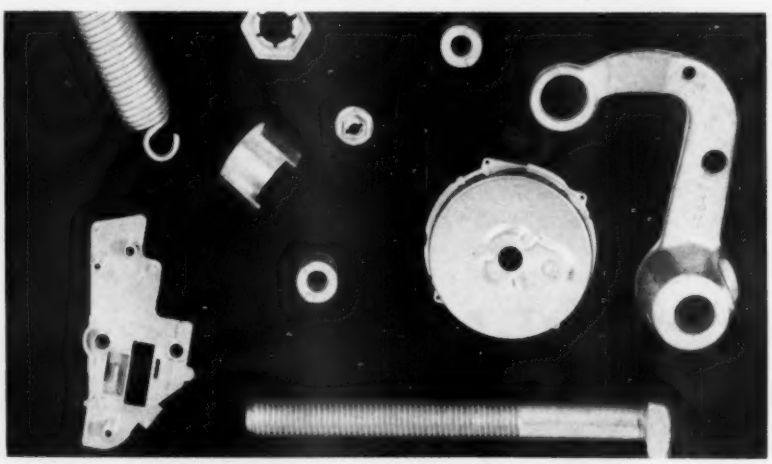
A new, mechanical plating system has been developed by the Minnesota Mining and Manufacturing Co. which is reported to eliminate hydrogen embrittlement, require a much lower capital investment and can be operated at lower costs than conventional plating methods.

The new process is primarily for applying protective coatings and is especially valuable for putting a non-corrosive surface on sinterings. Many applications of sinterings have to be given up because of corrosive atmospheres, the natural porosity of sinterings precludes good electro-plating as a protective measure.

The procedure for coating is simple. The clean parts are put into a rubber lined barrel with a special promoter chemical and a special impact media. The charge is covered with water and the barrel rotated for about 45 minutes. After plating the parts are washed and dried. Chemicals and water are thrown away and the impact media recovered for re-use. At present only zinc is being applied, but cadmium looks promising.



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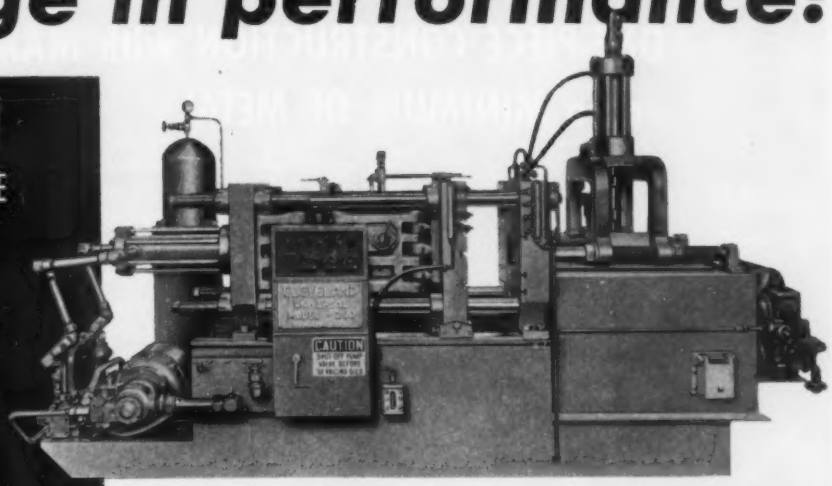

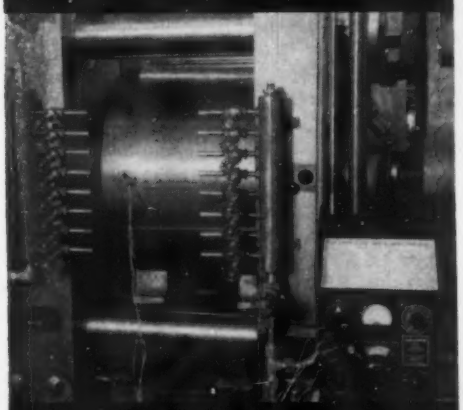

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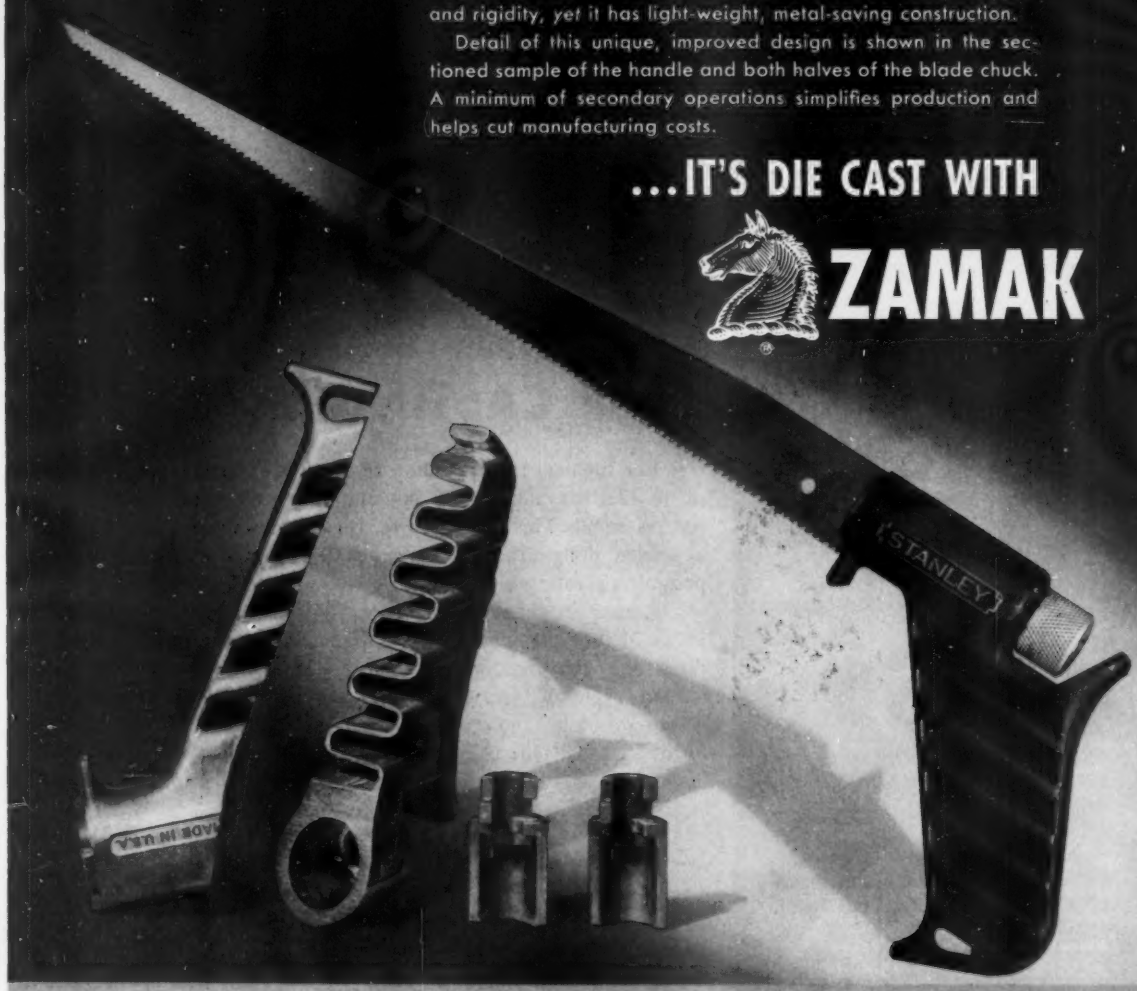
Detail of this unique, improved design is shown in the sectioned sample of the handle and both halves of the blade chuck. A minimum of secondary operations simplifies production and helps cut manufacturing costs.

...IT'S DIE CAST WITH ZAMAK



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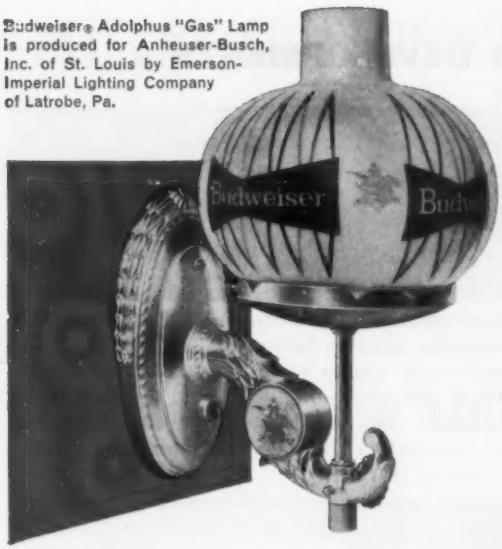

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add a bright new light to an effective sales technique

Here's point-of-sale advertising at its best—commandeering attention and holding its enviable and permanent position in the center of a highly competitive consumer market—creating impulses that roll into steady sales—continuously!

Yes, Budweiser® Adolphus "Gas" Lamps by Anheuser-Busch, Inc., do just that—doubly so, because they're installed in pairs, flanking the ends of thousands of backbars across the country.

So you order a "Bud"®, and your eyes dance over the quaint old-fashioned design of the Lamp's base, as you wait to be served. How sharp the minute details of the design in the base appear—and are! The smooth, even fit of the parts . . . the soft, golden finish that glistens so bright . . .

Now you know! That elegant, ornate base is L. D. C. Zinc Alloy Die Casting! It has captured and preserved all the warmth and friendliness of a Century passed through modern design techniques and color treatment that only quality workmanship through quality materials can produce.

L. D. C. Zinc Alloy Die Castings electroplate easily and retain a high gloss polished finish.

Dimensional stability and strength of L. D. C. Zinc Alloy Die Cast shells assure neat, accurate fit, and a smooth, even finish that sharpens design details.

Latrobe Die Casting Co.
LATROBE, PENNSYLVANIA

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Tel: Portage 2-7663

CLEVELAND, OHIO
William Kranz
20001 West Lake Road
Tel: Edison 1-6888

DETROIT, MICHIGAN
J. R. Lemen, Jr.
1016 Fisher Bldg.
Tel: Trinity 3-5910

NEW ENGLAND
R. L. Thomson
741 Glenbrook Rd.
Glenbrook Station
Stamford, Conn.
Tel: Fireside 8-3985

BUFFALO, N. Y.
Harry W. Harding
235 Burke Drive
Tel: Amhurst 1164

DAYTON, OHIO
J. M. Gallaher
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Tel: Baldwin 4-3523

PHILADELPHIA, PA.
Albert B. Reid
505 Wadsworth St.
Tel: Chestnut Hill 7-8833

Established 1918

Circle No. 50 on Reader Service Card

NEW PRODUCTS AND DEVELOPMENTS

Qualified readers can get complete details on these products. Use the Reader Service Cards. You'll find them facing page 128 of this issue

PORTABLE THICKNESS TESTER

MAGNAFLUX CORP.—The Sonizon SO-300 gives instant wall thickness readings between 0.025" and 2.5". The operator simply places a transducer on the surface to be tested and turns a dial. A liquid couplant transfers ultrasonic vibrations between the transducer and the test material. A thickness indicator then gives a direct reading in inches.

The tester is especially useful in checking core shift in castings. It is portable and completely transistorized. Tester and battery weigh less than 25 lbs.

Three knobs provide complete control of the entire test procedure. Accuracy is ±1% when calibrated against known samples of the same material.

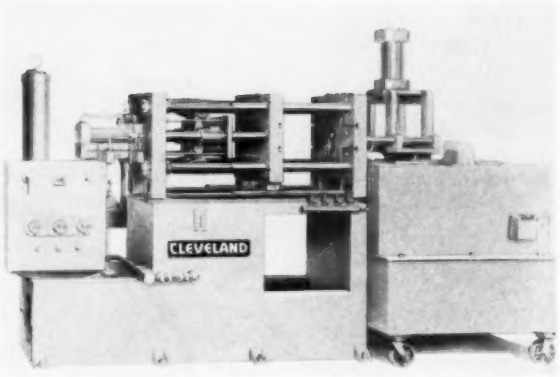
Circle No. 235 on Reader Service Card

100 TON DIE CASTING MACHINE

CLEVELAND AUTOMATIC MACHINE CO.—The Model 100 die casting machine has a strain gage tested locking pressure of over 100 tons. It is available as a standard or automatic hot chamber machine, or as a standard or vacuum cold chamber machine, with or without automatic ladling. Shot capacity is 21.6 lbs. aluminum or 4.2 lbs. zinc with standard plungers.

The furnace is mounted on casters so that it can be rolled away from the machine to remove the pot. In the operating position, locks on the casters prevent furnace movement.

Circle No. 236 on Reader Service Card



VACUUM PUMPING STATION

VEECO VACUUM CORP.—The VS-401 automatic, high vacuum pumping station reaches 5 x 10^{-6}mm Hg pressure in less than 35 seconds. Ultimate pressure is less than 5 x 10^{-7}mm Hg.

The complete operating cycle is controlled by two push buttons. One button starts the roughing cycle. A controller automatically switches from roughing to high vacuum at a predetermined pressure.

After completing a process, the operator presses a second button to automatically vent the system and prepare for the next cycle.

The front panel has an operating schematic diagram with signal lamps to show which valves are open during the cycle. The unit can be manually operated.

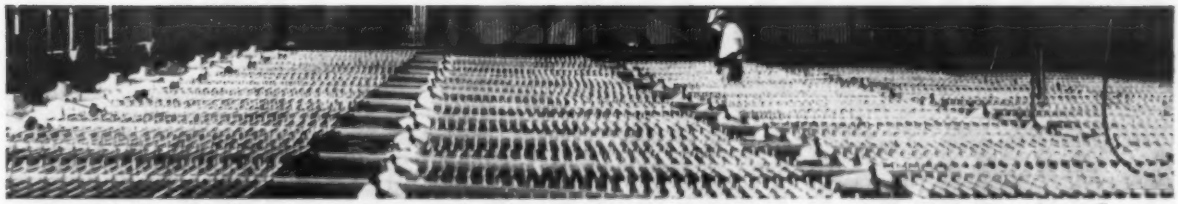
Circle No. 237 on Reader Service Card

continued on page 71

INTEGRATED PRODUCTION —from Ore to Ingot

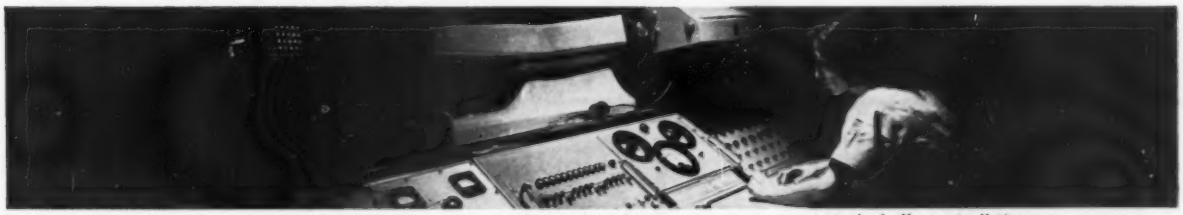
Underground scene in American Zinc's East Tennessee zinc mines. More than 50 years' reserve of zinc ore has been developed here.

Assures the Uniformity and Purity of



Cell room in American Zinc's electrolytic zinc plant at Monsanto, Ill. Special high-grade zinc is produced at this modern refinery.

AZCO Zinc Die Cast Alloys



Latest spectrographic analyzing equipment is employed to assure accurate control of alloys at all times.

You set your specification—get your specification with AZCO Zinc Die Cast Alloys. AZCO Alloys are produced from American Zinc special high-grade slab zinc—quality controlled from ore to ingot to assure the purity and uniform analysis you need for trouble-free production. From our Monsanto, Illinois, plant in the center of the "Zinc Zone," you get the fast, dependable service you need to meet your production schedules. Phone for immediate attention.

American Zinc sales company

1515 Paul Brown Building, St. Louis 1, Missouri
Distributors for:
AMERICAN ZINC, LEAD AND SMELTING COMPANY
Detroit • Columbus, O. • Chicago • St. Louis • New York

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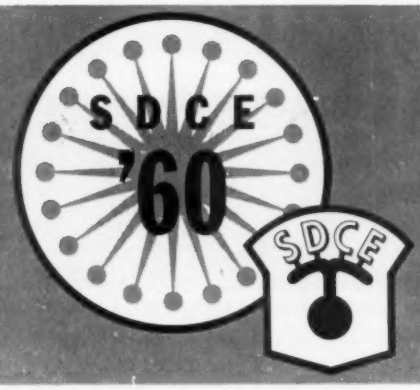
FIRST



NATIONAL DIE CASTING EXPOSITION & CONGRESS

NOVEMBER 8-11, 1960
DETROIT ARTILLERY ARMORY

AN UNPRECEDENTED OPPORTUNITY FOR

Die Casting Engineers

Die Casting Plant Management

Buyers of Die Castings

Metalworking Production Executives

Tool and Manufacturing Engineers

Die Casting Designers and Stylists

to **SEE, STUDY** and **LEARN** about the latest developments and trends in the dynamic die casting field.

EXHIBITS of die castings, die casting machines, dies, die steels, casting metals, production and finishing equipment, and die casting supplies and services.

A COMPREHENSIVE TECHNICAL CONGRESS

with 25 papers by outstanding authorities. Vital subjects to be discussed in the Congress include: Die Design, Die Building, Metallurgical Developments, What's Ahead in Die Castings, Competition to Die Casting, Cost and Profit, Quality Control and Vacuum Die Casting.

For further **INFORMATION** write or call The Society of Die Casting Engineers, 19382 James Couzens Highway, Detroit 35, Michigan, UNiversity 4-9116

BETTER
METAL CASTING WITH
HARBISON-WALKER
REFRACTORY MOLD MATERIALS

H-W Flintgrain for ceramic shell molds

H-W FLINTGRAIN is an alumina-silica product of high refractoriness having very desirable low thermal expansion characteristics.

The angular grain shape and optimum size distribution make H-W FLINTGRAIN ideal for securing maximum compactness in the mold. It is used with special benefit for making ceramic shell molds and for similar applications in which dense, compact mold sections of greatest volume stability at all temperatures are of paramount importance.

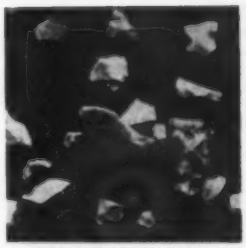


Illustration of angulate shape of H-W Flintgrain enlarged x3

H-W Mullite Grains and Flours for precision molding of metals at extremely high temperatures

These H-W Mullite products by virtue of their high-alumina composition and low content of basic oxides are exceedingly refractory. The hard dense grains are strong and most resistant to fluxing. Excellent thermal stability accounts for their unusual constancy of volume up to their temperature limit. The maximum thermal expansion of these mullite products is approximately 0.6 per cent which is less than half that of silica sand. These are the properties which make them especially suitable for precision casting work at high temperatures with particular benefit for various non-ferrous and ferrous alloys.

Illustrated here is a typical two-part mold in H-W Mullite material made for the precision casting of a beryllium-copper alloy.

HARBISON-WALKER REFRACTORIES CO. and subsidiaries

World's Most Complete Refractories Service **GENERAL OFFICES: PITTSBURGH 22, PENNA.**

HW 60.28

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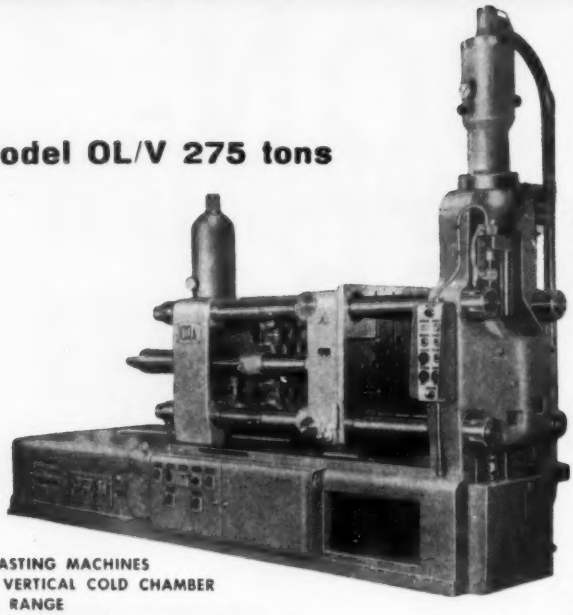
IDRA

DIE CASTING MACHINES

COSTRUZIONI IDROMECCANICHE BRESCIANE

Model OL/V 275 tons



DIE CASTING MACHINES
WITH VERTICAL COLD CHAMBER
OL/V. RANGE
Locking pressure: 110 - 165 - 275 - 440 tons.

WE MANUFACTURE DIE CASTING MACHINES WITH HORIZONTAL COLD CHAMBER, WITH HOT CHAMBER (FOR ZINC ALLOYS), WITH VERTICAL COLD CHAMBER. WATER HYDRAULIC DIE CASTING MACHINES

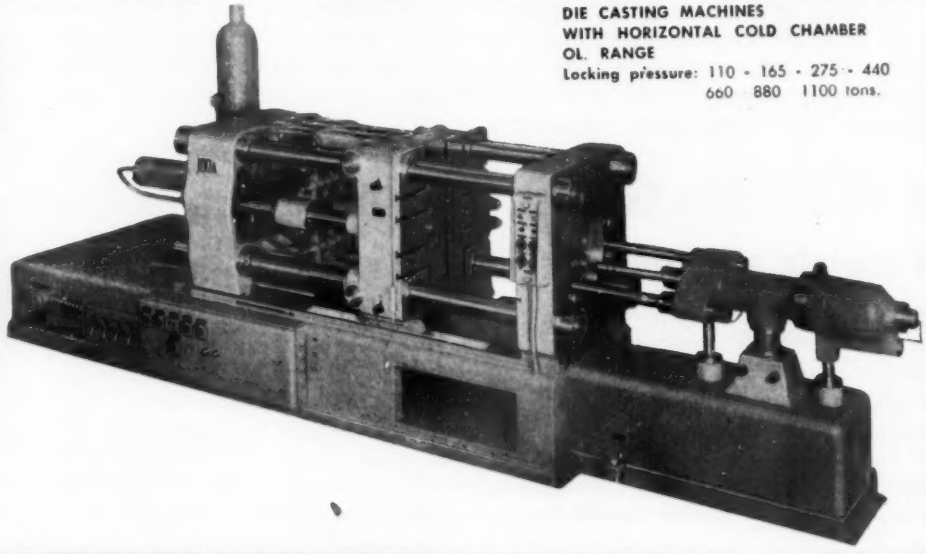
OL/V. RANGE

Locking force	Max. injection force	Dimensions of platens	Movable die platen stroke	Max. weight of castings (AL.)
110	17,6	20 3/16"x21 5/8"	9"	1,71
165	23	25 1/2" x25 1/2"	11 13/16"	2,86
275	38,5	31 7/8" x32 9/32"	14 3/4"	4,84
440	60,5	37 5/16"x37 5/16"	16 3/4"	16,28
tons.	tons.	inc.	inc.	lbs

OL. RANGE

Locking force	Max. injection force	Dimensions of platens	Movable die platen stroke	Max. weight of castings (AL.)
110	8,8	20 3/16"x21 5/8"	9"	2,64
165	16,5	25 1/2" x25 1/2"	11 13/16"	4,4
275	31	31 7/8" x32 9/32"	14 3/4"	6,6
440	44	37 5/16"x37 5/16"	16 3/4"	12,76
560	60,5	45" x45"	18 11/16"	17,6
880	82,5	51" x51"	20 5/8"	30,8
1100	88	57 1/2" x57 1/2"	23 5/8"	39,6
tons.	tons.	inc.	inc.	lbs

Model OL 440 tons



DIE CASTING MACHINES
WITH HORIZONTAL COLD CHAMBER
OL. RANGE
Locking pressure: 110 - 165 - 275 - 440
660 - 880 - 1100 tons.

pubblicita
IDRA n. 715/60

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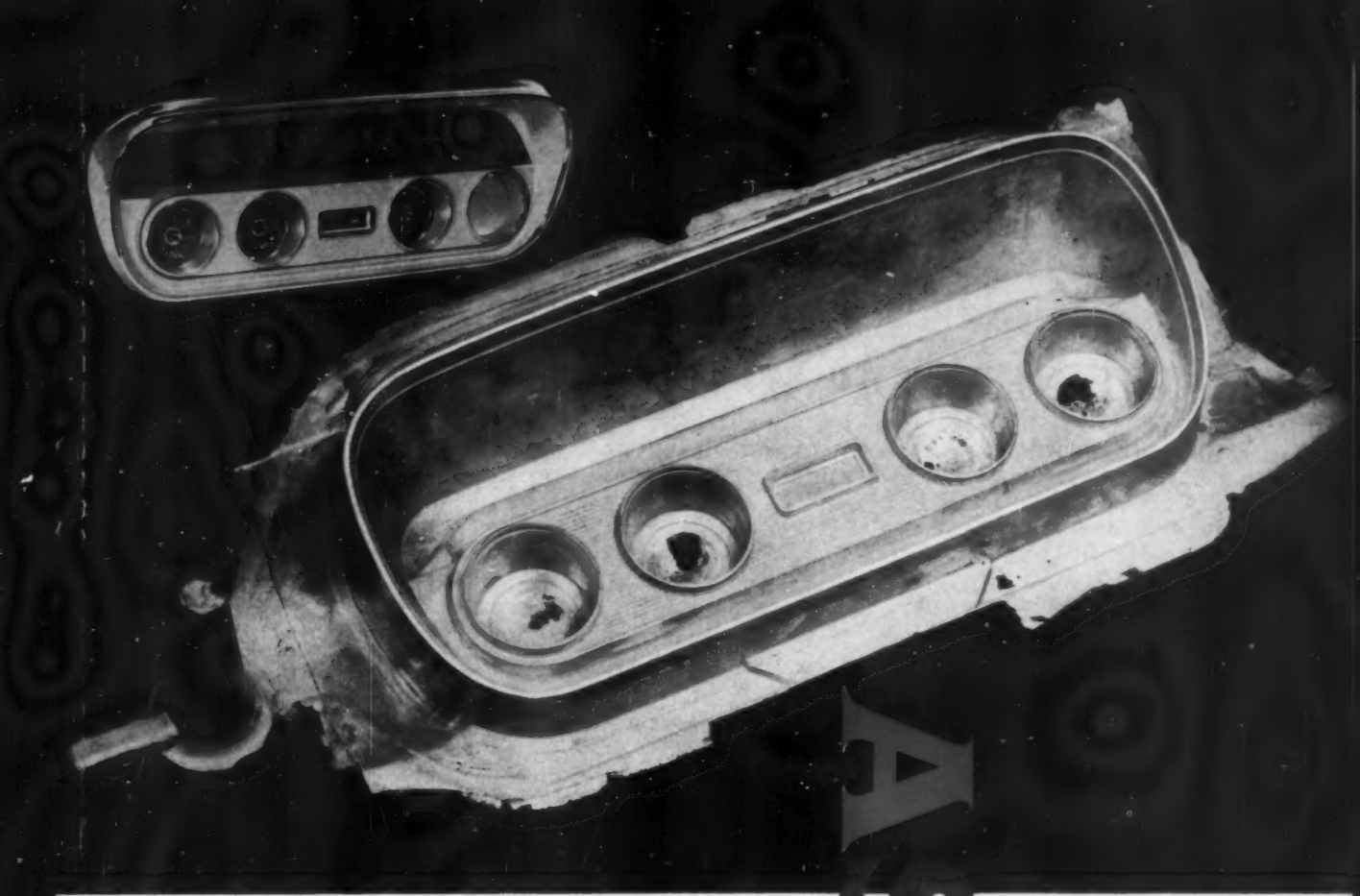

Unmatched purity and uniformity:

FEDERATED ZINC DIE CASTING ALLOYS

Completely controlled production provides you with die cast metals of highest purity and uniformity. Federated Zinc die cast metal is made from ASARCO Special High Grade Zinc, electrolytically refined by Asarco-developed processes. Production is concentrated "under one roof" at Corpus Christi, Texas, one of the world's largest plants producing Special High Grade zinc and die casting alloys. Strategically located warehouse stocks assure you of prompt volume delivery. For complete information about FEDERATED Zinc Die Casting Alloys, write or call: Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y. or your nearby Federated sales office.

ASARCO

AMERICAN SMELTING AND REFINING COMPANY

Low machining costs, superior castability, and an excellent plating surface are the big reasons why zinc die castings are favored for fuel pumps, carburetors, grilles, lamp housing, instrument panels, horn rings, and many other functional and decorative automotive components.

FEDERATED METALS DIVISION

Where to call for information:

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St. Louis: Jackson 4-4040

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Orleans 5-2400

BIRMINGHAM, ALA.
Fairfax 2-1802

BOSTON 16, MASS.
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CHICAGO, ILL. (WHITING)
Chicago: Essex 5-5000
Whiting: Whiting 826

CINCINNATI, OHIO
Cherry 1-1678

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DALLAS, TEXAS
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Newark: Mitchell 3-0500
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Locust 7-5129

PITTSBURGH 24, PENNA.
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Main 3-7160

WHITING, IND. (CHICAGO)
Whiting: Whiting 826
Chicago: Essex 5-5000

IN CANADA: Federated Metals Canada, Ltd.
Toronto, Ont., 1110 Birchmount Rd., Scarborough, Phone: Plymouth 73246

Montreal, P.Q., 1400 Norman St., Lachine, Phone: Melrose 7-3591

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HIGHLIGHTS OF ADCI CONFERENCE

PMM SCHOLARSHIP

PRECISION METAL MOLDING has established an annual "Irving B. Hexter—Precision Metal Molding Magazine Memorial Award" in the form of a scholarship to perpetuate the memory of Hexter, who contributed greatly to the die casting industry as PMM's publisher.

The recipient of the scholarship will be determined by The Educational Committee of the Die Casting Research Foundation Fund for Engineering Education which sponsors a program of scholarships at selected engineering schools.

LILLEGREN AWARDS

The initial Austin T. Lillegren Awards were presented to A. W. Simpson, III, President, Western Die Casting Co. and to G. F. Hodgson, Doehler-Jarvis Div., National Lead Co.

The award was established by the ADCI Board of Directors to perpetuate the memory of Lillegren, Past President and Director of the ADCI and Chairman and Trustee of the Die Casting Research Foundation. At the time of his untimely death last May, Lillegren was Vice President of the Madison-Kipp Corp.

The award is presented annually to a person, or persons, in the ADCI —Die Casting Research Foundation for extra-ordinary service to the Institute and Foundation.

This year's award was presented at the ADCI Banquet by Gordon C. Curry, ADCI President.

BLACKMUN RECEIVES DOEHLER AWARD

BLACKMUN

The Annual Doehler Award, highest honor of the die casting industry, was presented to E. V. Blackmun, Assistant Chief Metallurgist, Fabricating Division, Aluminum Company of America, at the ADCI banquet. The Doehler Award, established in 1949 by the Doehler-Jarvis Corporation, recognizes outstanding contributions to the advancement of the die casting art. Three considerations govern the ADCI Board of Directors, serving as the Award Committee, in the selection of the recipients of the Doehler Award: technical achievement; advancements in plant operations; other activities not primarily of a scientific or operational nature.

The award, consisting of a certificate, a plaque and a cash honorarium, was presented to Blackmun, by Dr. Matthew A. Hunter, Dean Emeritus of Rensselaer Polytechnic Institute.

ADCI NAMES OFFICERS

Gordon C. Curry, President, Walter E. Brown, Vice-President and David Laine, Secretary were re-elected to their American Die Casting Institute offices for the new year. Curry is Vice-President in charge of sales of the Dollin Corporation, Brown is Executive Vice-President of the Kiowa Corporation, Laine has been ADCI Secretary since 1944.

Each of the four ADCI regional groups elected a director to the Institute National Board. W. G. Newton, Jr., President, The Newton-New Haven Co., was re-elected as Director by the Eastern Regional Group. A. D. Weigolt, Vice-President—General Manager, Precision Castings Company, was newly elected to the Board by the Central Regional Group. Fred Klement, President, West Irving Die Casting Co., is a new Director from the Midwestern Regional Group. E. M. Woods, Partner, Aluminum Die Casting Co., was re-elected to the Board by the Pacific Coast Regional Group. Re-elected by the ADCI membership as Directors-At-Large are F. W. Burgie, Manager of Sales, Doehler-Jarvis Div., National Lead Co., and Alfred Schneier, Jr., Vice-President, Advance Pressure Castings Corp. Newly-elected Directors-At-Large are J. C. Bennett, Executive Vice-President, Harvill Corporation, and Walter E. Brown, Executive Vice-President, Kiowa Corporation.

Elected 1961 Chairman of each

more industry news on page 22

CURRY

BROWN

FEIL

KLEMENT

WOODS

DRESS

THE MAN FROM MUELLER BRASS CO.

REPRESENTS ONE DEPENDABLE SOURCE FOR PARTS FABRICATED TO YOUR SPECIFICATIONS FROM COPPER, BRASS, ALUMINUM AND PLASTICS

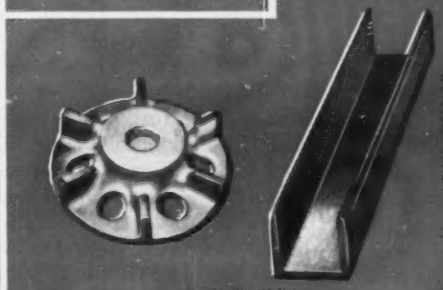
In today's market, the Man From Mueller Brass Co. can help you save both time and money. Mueller Brass Co. offers a variety of production methods and you get an unbiased opinion on the most practical and economical way to make your specific part . . . hence you save time in planning and engineering, and money in production. Consult the Man From Mueller Brass Co. . . . you'll find he's a good man to know . . . and Mueller Brass Co. a dependable source for fabricated parts.

Write today for information on any of the many quality products shown here.

FORGINGS

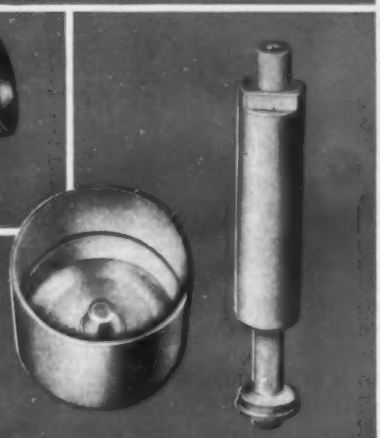
POWDERED METAL PRODUCTS

FORMED COPPER TUBE



CUSTOM EXTRUDED PLASTIC SHAPES AND INJECTION MOLDINGS

SCREW MACHINE PRODUCTS



COLD-PREST IMPACT EXTRUSIONS

MUELLER BRASS CO., PORT HURON 39, MICHIGAN

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of the four ADCI Regional Groups are W. F. Feil, Aluminum Company of America, Eastern Regional Group; Norman Dress, Precision Castings Company, Central Regional Group; Fred Klement, West Irving Die Casting Co., Midwestern Regional Group; and E. M. Woods, Aluminum Die Casting Co., Pacific Coast Regional Group.

WINS ZINC DIE CASTING AWARD

Anderson and "Zinc Die Casting of the Year"

New Jersey Zinc officials, Maxon and Worley, confer with judges Kewley, Kermott, and Schaum.

The "Zinc Die Casting of the Year Award was presented to Victor O. Anderson, A & A Die Casting Inc. at the 1960 Annual Meeting of the American Die Casting Institute held in Chicago last month. The honor, consisting of a certificate and cash prize of $1000, is awarded by the New Jersey Zinc Co. to the employee of a die casting producer responsible for the design and production of an outstanding zinc die casting. The casting must represent a unique application or a cost-saving conversion from another production method.

The winning casting is a vacuum chamber for an Ampex computer tape handler. It is 32" long, 3.25" wide, and 1.5" deep. Wall thicknesses vary from .025" to .175". Judges in the competition were Ralph G. Dermott, Metal Progress Magazine; Norman E. Kewley, General Electric Co.; and J. H. Schaum, Modern Casting magazine.

DIE CASTING SHOW TECHNICAL PROGRAM

The technical program has been announced for the First National Die Casting Exposition & Congress.

The Society of Die Casting Engineers are sponsoring the event to be held in the Detroit Artillery Armory from November 8 to 11. An attendance of over 10,000 is expected.

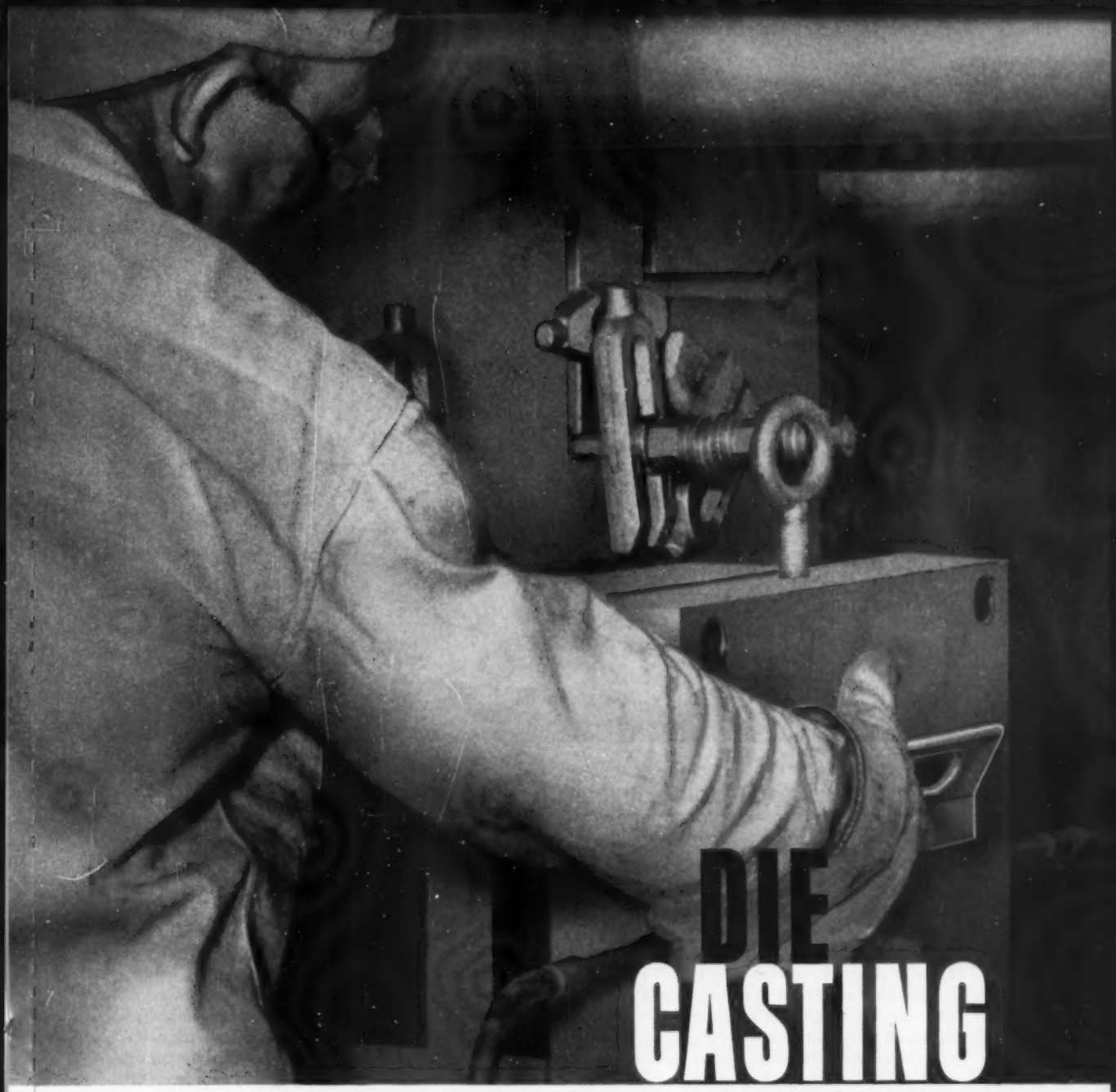
Papers to be presented on Nov. 8 are: Mathematical Determination of Die Design; Further Remarks on Gate Design in Aluminum Die Casting; Mold Fabrication—Cost Reduction and Control; H-13 Steel as Used in the Die Casting Industry; and Temperature Related to Molds and Casting Properties.

On Nov. 9: Studies on the Influence of Gas Content, Pressure, and Magnesium Content on the Mechanical Properties of Aluminum Die Castings; Alloy Control for Zinc Die Castings; Metal Handling and Control; Metallography of Die Castings; Ultrasonic Vibrations in Die Casting Production; Plating and Anodizing of Aluminum Die Castings; and How Castings Affect Quality of Electroplated Zinc Die Castings.

On Nov. 10: Modern Permanent Molding as a Process for the Foundry; Impact Extrusions Today; Sand Casting Process, A Competitor of Die Casting; Dictaphone Experience in Designing and Engineering Components; Plastics—Competitor of Die Castings; Automation and "Make or Buy"; Short Runs; and Advances in Impregnation Materials and Techniques.

On Nov. 11: Quality Evaluation —Techniques and Procedures; Effect on Product Quality of Cavity Design, Tool Installation and Machine Operation; Casting, Trimming & Handling Techniques for Obtaining Quality Die Castings; Review of Methods to Obtain Improved Corrosion Resistance for Plated Zinc Die Castings; Vacuum Die Casting—A Resume of Progress to Date (this paper presented by Hiram K. Barton, PMM's European Editor); Some Effects of Vacuum Casting on Surface Finish; and Use of Vacuum in Production Of Anodizable Quality Aluminum Die Castings.

more industry news on page 124



Die casting an important product—control panel component—for the electronic data processing industry.

Designing, Engineering, Die Making and Casting are Southern Die Casting services that help you produce a better product at lower cost. Modern casting techniques – including the Vibrocast process – and specialized, high-speed equipment provide you with stronger, more precise parts cast in non-ferrous alloys. From metallurgy to machining . . . from tooling to technology, there's a specialist with years of experience to serve you. For fast, dependable service for *your* die casting needs, write today!

SOUTHERN DIE CASTING & ENGINEERING

206 Albertson Road / High Point, North Carolina

Sales territories are available for representation. Write to John A. Weber, Vice-President.

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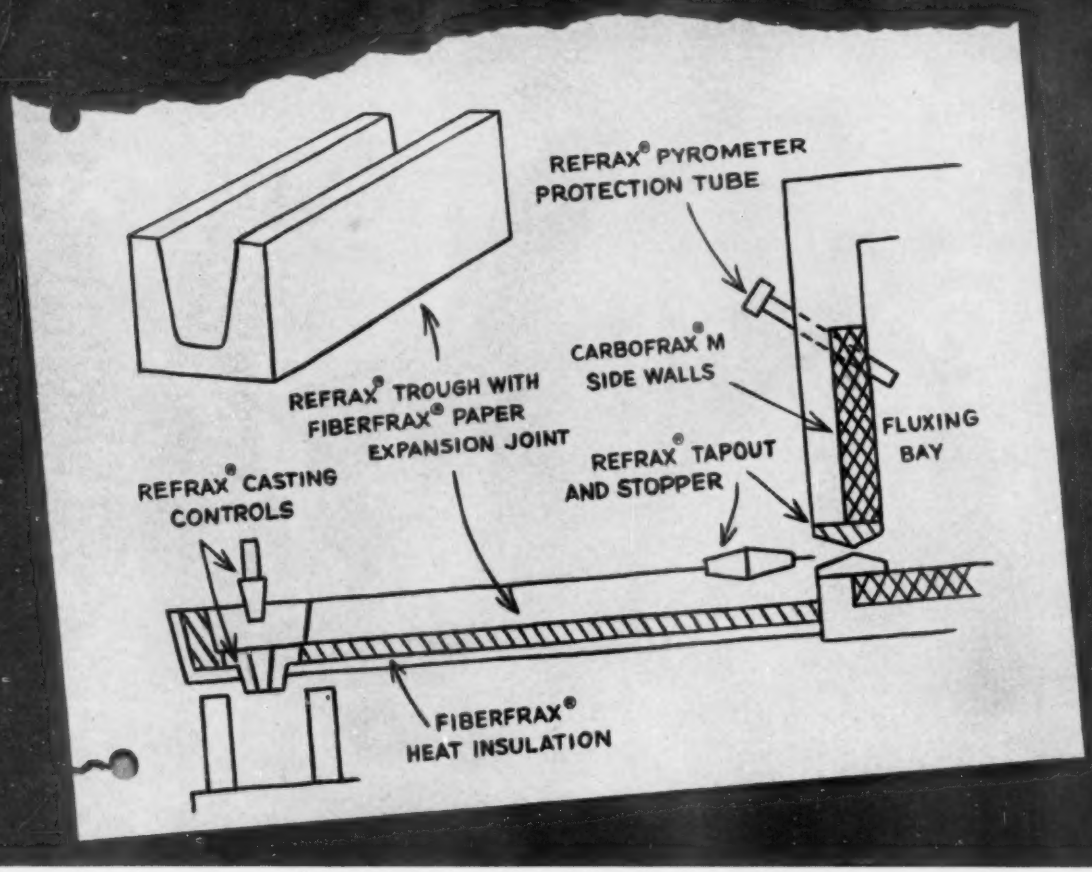
The Hallmark of Southern Die Casting and Engineering, a mark of quality.



Design hints on refractories for aluminum furnaces

How to reduce casting trough and launder problems

These problems are solved by a special refractory. It is REFRAX® *silicon-nitride-bonded silicon carbide.* This material requires less maintenance, eliminates inclusions and assures easier cleaning.

In short, its unusual properties provide virtually trouble-free service in these locations. Metal penetration is avoided; no chemical reactions occur and erosion by the molten metal cannot be detected.

Where several trough lengths are required, joints should be filled with FIBERFRAX® paper. It, too, resists metal penetration and attack.

Special-purpose refractories made by Carborundum offer a choice of materials to meet widely varying needs in other critical areas of aluminum-melting furnaces.

CARBOFRAX® *ceramic-bonded silicon carbide,* for example, is made in a variety of compositions suitable for hot walls, side walls, bottoms, charging ramps and door jambs and sills. REFRAX *silicon-nitride-bonded silicon carbide* can be supplied in accurately dimensioned shapes with high strength and resistance to thermal shock. It is not wet by molten aluminum. Special uses are found in furnaces subject to intermittent operation. ALFRAX® *fused alumina bubble insulating brick* are light in weight, withstand high temperatures and have the low heat transfer qualities needed in walls and roofs above the metal line. MULLFRAX® *electric furnace mullite* offers resistance to flame erosion and spalling plus low heat conductivity. It is widely used for burner blocks.

For assistance and recommendations on how to engineer refractories to your specific furnace needs contact Dept. R-100, Refractories Division, The Carborundum Company, Perth Amboy, N. J. Phone: Hillcrest 2-3380.

For engineered refractories . . . count on

CARBORUNDUM®

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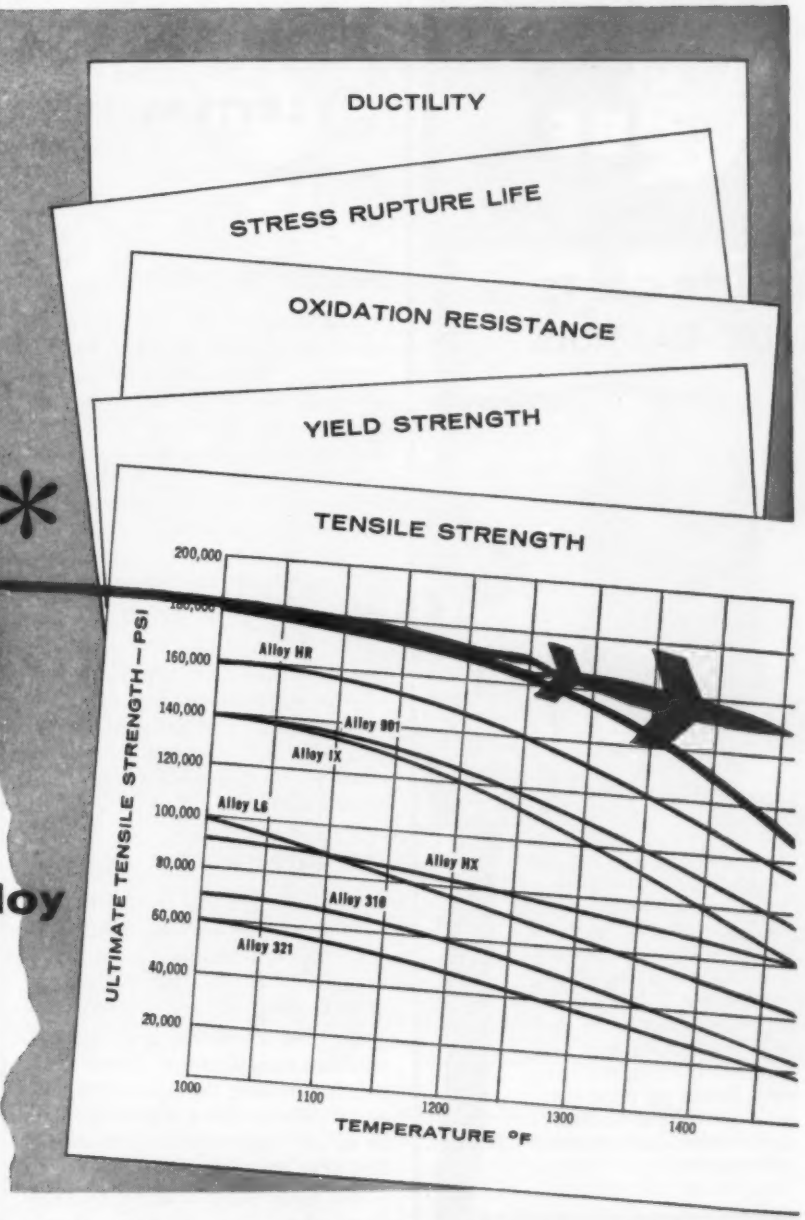
HIGH

on every chart:

RENÉ 41*

most dependable alloy in use today in the 1200°- 1800° F range



In *all* ways, René 41 is a remarkable alloy. No other high-temperature alloy used in production today equals its tensile strength. In other properties, too, René 41 is far ahead of the field.

Also important, this nickel-base, vacuum-melted alloy is easy to work with. It's readily formable by drawing, bending, spinning — welds to similar or dissimilar materials.

Cannon-Muskegon offers René 41 in standard 36″x 96″ sheets .015″ to .125″ thick, in smaller sizes down to .010″, in bar stock up to 3″ in diameter . . . foil down to .001 in thickness . . . and fine wire only .0015 in diameter.

For complete details, write for Technical bulletin No. 86.

*TM of General Electric Co.

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2871 Lincoln Avenue • Muskegon, Michigan

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AIR-LUBE SYSTEM

CUTS COSTS for DIE-CASTERS

• CLEANS
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Remove loose flash and clean the mold with a powerful, clean air blast — then lubricate all mold surfaces evenly, *using the same gun* —with a flick of the thumb! Adjustment *at the gun* for full range from zero to a heavy mist, spraying, fogging, or vaporizing the lubricant. Speeds up mold operation and reduces casting rejects. Makes every machine cycle count.

USED IN LARGE AND SMALL SHOPS EVERYWHERE!

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PMM LETTERS

the readers' forum

PLATING MAGNESIUM

Not covered in your article on electroplating magnesium are the names of companies who are set up to do this work. We would appreciate your directing us to them or have them get in touch with us. We would like to know the limitations of the process, such as tank size, particular alloys not suitable for plating, and relative cost. C.P.M.—Senior Mechanical Engineer.

We do not know the names of companies who are experienced in plating maginesium and its alloys. However, we will be glad to forward the names of any companies who can do this work if they will write PMM.—Ed.

SCHMIDT PROCESS

The article on the Schmidt process of casting aluminum was extremely interesting to us. We use die castings and permanent mold castings in large quantities.

Do you know of any molding machine manufacturer who is considering making the Schmidt equipment? Would Reynolds Aluminum be of any assistance in introducing this new process?

We have been waiting to hear more about this process and we compliment you on being the first to publish, in this very competitive field. P.M.N.—Development Engineer.

To the best of our knowledge, there are no companies in this country making equipment for casting by the Schmidt process. At the Chevrolet plant in Massena a few of the units were imported from Germany and the rest were built by General Motors. We hope to have another article in the near future which will give more complete details of the equipment and the process.—Ed.

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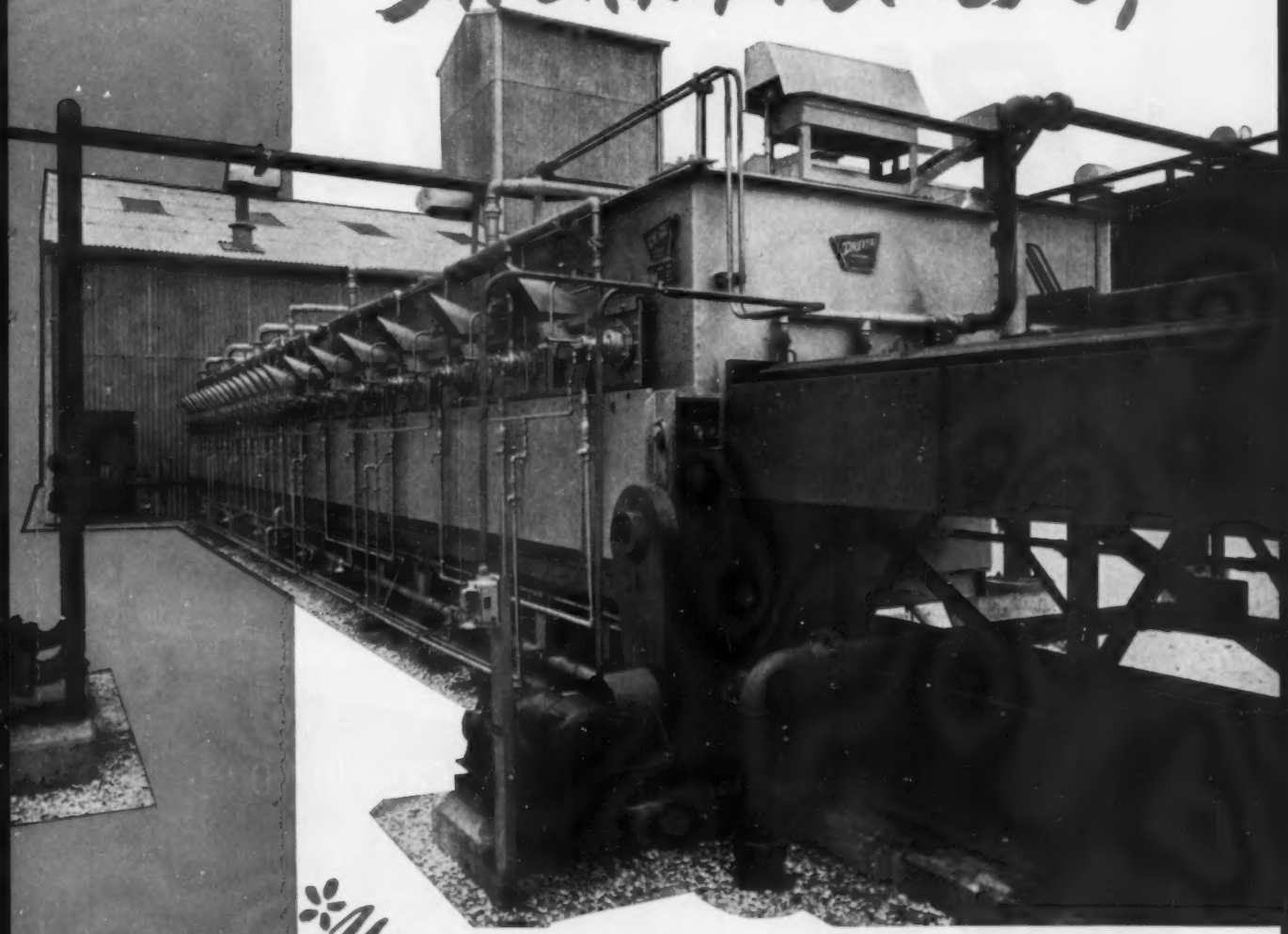
SINTERING AL FRESCO!*



*Yes, OUT-OF-DOORS! Here's a Drever Furnace installation for sintering nickel briquettes at the plant of the Freeport Nickel Company, Port Nickel, Louisiana. Its outdoor setup eliminates the need for costly building space—but this is only one of its interesting features.

HIGH LOAD CAPACITY—AUTOMATED OPERATION

Built to handle continuous in-line 8800# per hour production of sintered nickel briquettes, this Drever Furnace combines the high loading capacity of a roller hearth with the material handling convenience of a conveyor belt furnace. It is a radiant-tube, natural gas fired, roller hearth type furnace, gas tight for controlled atmosphere operation.

NO TRAY LOADING OR UNLOADING

Material passes through the furnace on a continuous mesh belt which allows greater circulation of heat and gas for uniform production and eliminates the need for trays. Automatic handling equipment loads briquettes onto the belt and conveys the sintered briquettes from the end of the furnace for weighing and packaging.

DREVER ENGINEERING FOR YOU

This unique out-of-doors installation is an example of Drever application of sound engineering principles, and experience in the field of furnace design. Our engineering staff is available for consultation concerning your requirement—write or phone us. Drever Company, Bethayres, Pa. Phone: Wilson 7-3400.

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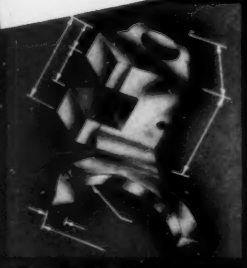
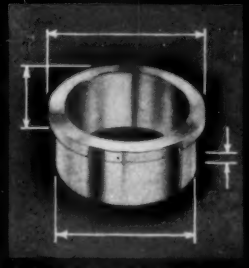
engineering for **both** cost and mechanical requirements in the bearing field . . .

Bunting can help you identify and procure the bearing or part that will do your job at the lowest possible cost. Often a re-examination of the actual mechanical needs of a bearing application reveals an opportunity to save money in design. Another saving is almost invariably achieved by considering ALL the new bearing materials which Bunting makes available to you today. Let Bunting help you engineer your bearing application in the light of modern availabilities. Send in your blueprints or ask for engineering counsel.

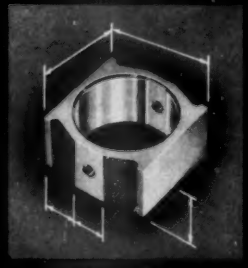
. . . case in point *



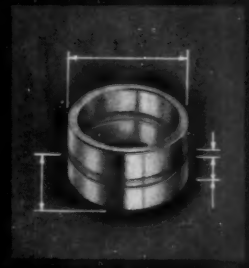
*Clearly evident is the economy in the production of this shifter fork by Bunting Powder Metallurgy. The elimination of machine work effects striking cost reduction.



*This cylinder gland bearing made of Bunting Bearing Aluminum is an example of how to save weight and money on the cost of large, thick-wall bearings and parts.



*This cast bronze cam block, made to unusually close limits with very fine finish, is absolutely round and true to size with cost at a feasible figure.



*Solid cast aluminum gear bearing to replace roller bearing for longer life and lower cost.

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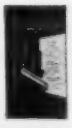

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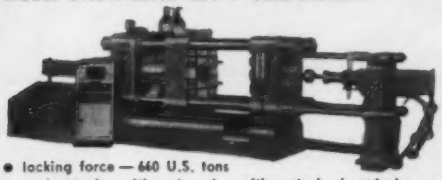
TRIULZI

Assembly Hall

Machine Shop

Model CASTMATIC 600 T cold chamber



- locking force — 660 U.S. tons
- wedge lock positive clamping with motorized central screw for platens adjustment
- max. casting weight — 20 lbs. (Al. alloys)
- dry cycles — up to 240 per hour

DIE CASTING MACHINES from 30 up to 2500 tons

castmatic

SELF-CONTAINED
(Vickers equipment)
AUTOMATIC
with pre-selecting panel for
8 different working programs

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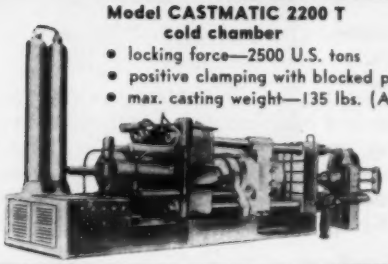
Model CASTMATIC 2200 T cold chamber

- locking force—2500 U.S. tons
- positive clamping with blocked piston
- max. casting weight—135 lbs. (Al. alloys)

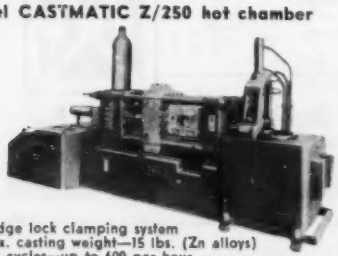


FAST CYCYLING OIL HYDRAULIC PRESS FOR SHEARING SPRUE AND BURRS

Model TRIM 50 T

- dry cycles—up to 600 per hour

Model CASTMATIC Z/250 hot chamber



- wedge lock clamping system
- max. casting weight—15 lbs. (Zn alloys)
- dry cycles—up to 600 per hour
- locking force 275 U.S. tons

Model CASTMATIC 150

- locking force—165 short tons
- toggle clamping system
- max. casting weight—5 lbs.
- dry cycles—up to 1140 per hour

CHECK-and DOUBLE CHECK!

Nothing is taken for granted in producing DOLLIN DIE-CASTINGS

- ☑ DESIGNS
- ☑ DIES
- ☑ METALLURGY
- ☑ CASTINGS
- ☑ MACHINING
- ☑ INSPECTION
- ☑ SCHEDULES

checked at every step

You can depend on Dollin to deliver on-grade, on-size die-castings . . . on time. Dollin combines extensive, high-speed equipment with a thorough system of production checks and quality controls to meet your strictest requirements. For example:

Dollin guarantees all zinc alloys under the "C-Z" Certified Zinc Alloy Plan. Aluminum alloys are carefully controlled—spectrographically certified, if needed. Continuous floor inspection is given castings at each stage of production. In addition, final inspection is made by trained inspectors. Sales service managers constantly check progress, maintain schedules, give you prompt answers on any job details.

If you're looking for a reliable die-caster with the know-how and equipment to produce quality die-castings at attractively low prices . . . send your prints or samples of parts to Dollin for engineering advice and quotation, without obligation. Write for the 16-page Dollin illustrated facilities booklet.

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See "Yellow Pages" for nearest office.

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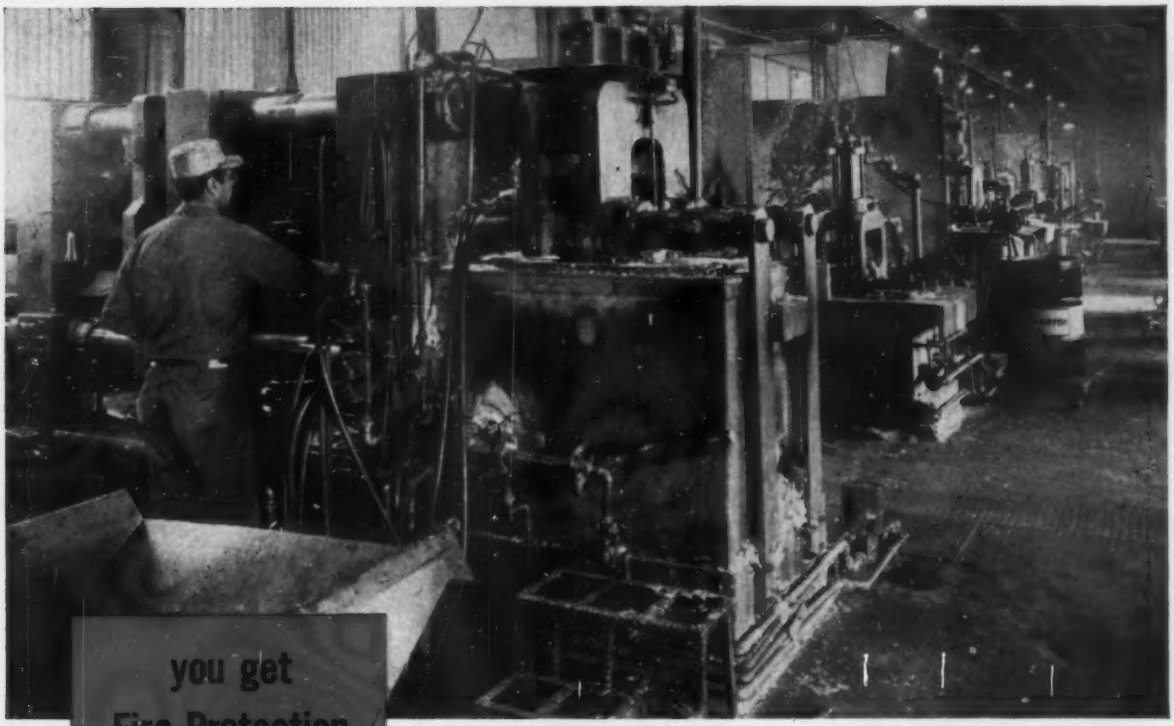

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Fire Protection
and
Wear Protection
with
HOUGHTO-SAFE

HOUGHTON
THE ONLY
COMPLETE LINE OF
PACKINGS & FLUIDS
FOR
INDUSTRIAL HYDRAULIC
SYSTEMS

Shown above are some of the machines in a mid-western die casting plant that have been operating with Houghto-Safe 600 series for up to 7 years!

Not one of these machines has been shut down because of pump failure due to faulty lubrication!

These machines have clocked over 25,000 hours with pump cartridges replaced only at scheduled overhaul periods. Here is the record:

Machine No.	Pressure (psi)	Hours Run on Houghto-Safe
1	1,000	17,794
2	1,000	20,096
3	1,000	25,496
4	1,000	15,128
5	1,000	25,596
6	1,350	18,122
7	1,000	20,162
8	1,750	5,376

Houghto-Safe 600 series is Houghton's *fortified* water-glycol type hydraulic fluid—and it is this unique fortification that gives this fluid its unusual lubricating qualities.

If you operate hydraulic equipment anywhere near open flame or high heat, you can protect your personnel and plant against hydraulic oil caused fires and protect your equipment against needless wear with Houghto-Safe. Write for new Houghto-Safe Bulletin to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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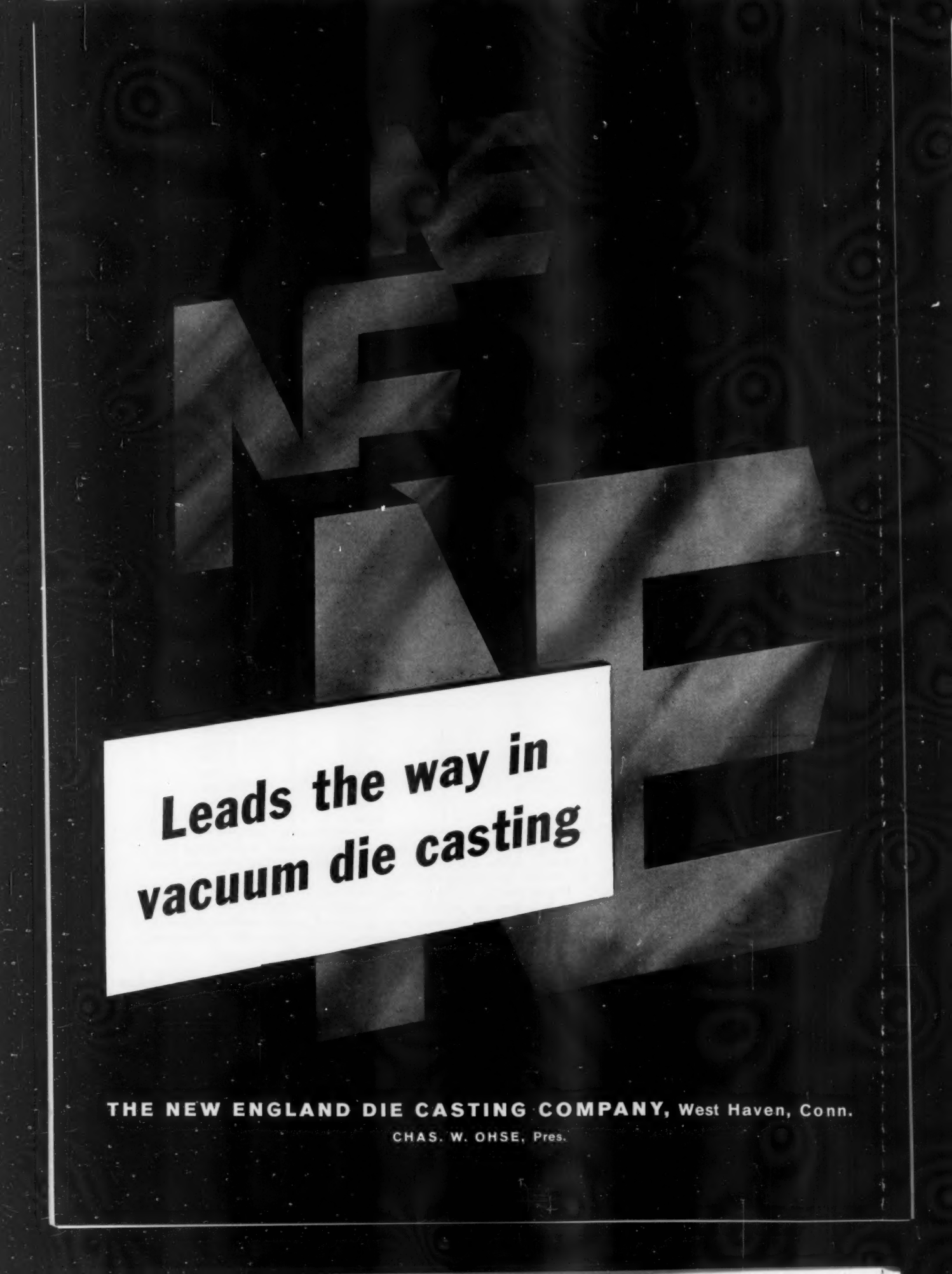

NE
Leads the way in
vacuum die casting
THE NEW ENGLAND DIE CASTING COMPANY, West Haven, Conn.
CHAS. W. OHSE, Pres.

MEASUREMENT OF PERMEABILITY OF INVESTMENTS

By JOHN S. SHELL*

THE GAS PERMEABILITY of investments is a vital factor in the investment casting operation. At the instant the casting is made, the gas in the mold must be eliminated rapidly to prevent its inclusion in the metal, either on the surface of the casting or in the interior. Proper spruing and gating is essential, but a portion of the gas must pass through the investment.

Many tests have been made on the permeability of investments at room temperature, but cooling the mold to room temperature may change the permeability considerably. Permeability tests, to be significant, should be made at the time and temperature at which the casting is to be made. Using the equipment diagrammed in Figure 1, this measurement is now possible.

The investment is poured against a monel adaptor which is attached to a monel tube. The adaptor is designed with internal and external seals to prevent possible leaks resulting from unequal expansion of the metal and investment. The equipment may be examined for leaks by placing a moderate pressure of 10 cm of mercury on the system when the adaptor with the green investment is attached. The adaptor and the investment are then placed in a furnace and the same heating cycle is followed that would be used in a customary routine casting. At the temperature at which the casting would normally be made, the air pressure is introduced and the gas flow rate is measured on the flowmeter. Pressures of 12 p.s.i. have been used.

The flowmeter may be calibrated by substituting a needle valve for the adaptor, adjust the readings, and collecting the gas in a burette for a controlled period of time. The same pressure may be used which was employed in the test.

Permeability measurements may be made with or without a flask. Wax may be placed on the end of the adaptor then burned out during the customary heating cycle to correspond to normal dewaxing procedures. Measurements may be made using different amounts of wax, different types of wax, and different burn out procedures. The investment may be poured so that different distances from the end of the adaptor and the bottom of the flask will be obtained. This determines the effect on permeability of different thicknesses of investment. Permeability using various water-investment ratios and many other modifications of the investing technique, such as vacuum investing, may be measured.

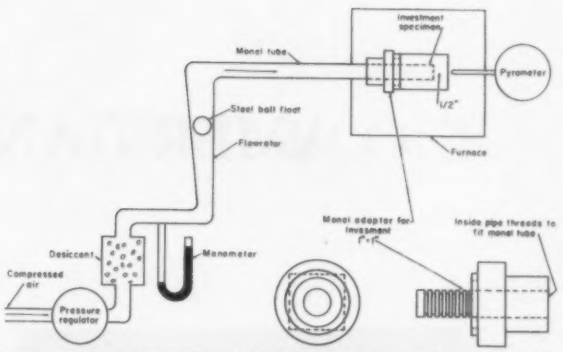


FIG. 1 SCHEMATIC DIAGRAM of apparatus for measuring permeability of investments at elevated temperature.

Many gas flow measuring devices are designed so that the gas is partially saturated with water vapor. Such flow meters will not give significant results because of the back pressure effect of the steam produced when the moist gas enters the heated investment. With the present equipment, the gas used to measure the flow is dried before it enters the system by passing it through a dehydrator and not allowing it to contact any moisture in the balance of the system. Water from the investment may collect in the monel tube during the burn out, and this must be eliminated before the test is made. This can be done by heating the monel tube, but it has been found more convenient to allow a small amount of dry air from another circuit to flow through the system during the burn out at a pressure of about 5 centimeters of mercury. This retains the system in a moisture free condition preparatory to the test.

This instrument may be used to determine the time-temperature burn out cycle required to dry the investment and eliminate the wax. If insufficient time is allowed for the burn out to complete, a back pressure resulting in a low reading will be observed. The flowmeter reading increases to a maximum as the burn out proceeds and then remains quite constant. By using this test, it may be possible to reduce the burn out cycle which, in the past, has been determined empirically.

* *Formerly Director of Research, Ranson & Randolph Co. Now associated with J. F. Jelenko & Co.*

A SPECIAL REPORT BY PMM BASED ON INTERVIEWS

WITH ENGINEERING EXECUTIVES

AMERICAN MOTORS REPORTS

The 1961 Rambler Classic Six

A report on an interview with
ELMER W. BERNITT, *Vice-President—Automotive Operations, and* RALPH H. ISBRANDT, *Director of Automotive Engineering and Research, American Motors Corp.*

THE 1961 RAMBLER Classic Six will have an aluminum die cast cylinder block. The change to an aluminum engine will give customers an improved product.

The aluminum engine is a big advance in the art of engine design. The die cast cylinder block is the first step. It is probable that all automotive engines will eventually have aluminum cylinder blocks. The entire industry will change over where volume is sufficient to justify it.

An aluminum engine is not new. For years, travelers have trusted their lives to aluminum aircraft engines. Also American Motors have built and have in operation, military ground vehicles with aluminum engines. These ground vehicles have sand cast components, but they are prototypes of die castings. If the volume use becomes great enough the engine can easily be die cast.

"ELIMINATE THE HUMAN ELEMENT"

One of the biggest advantages of the die cast engine is the elimination of the human element in the casting process . . . in sand or semi-permanent mold casting, human fallibility is a factor in such operations as making and placing cores, ramming the molds, pouring the metal, placement of chills, and many others.

With a die cast block, when the engineering is done (and it's difficult, detailed engineering) the product is a nearly fool-proof casting which fits into an automated production line.

ELMER W. BERNITT, vice-president of automotive operations for American Motors. His field covers styling, engineering, manufacturing, and procurement. Bernitt joined Nash Motors Div. of Nash-Kelvinator Corp. in 1938 as plant engineer. Promoted to general works manager, Kenosha works, in 1948 and elected vice-president, automotive manufacturing, in 1954.

RALPH H. ISBRANDT, director of automotive engineering and research for American Motors. One of the pioneers in the use of aluminum in automotive engines, Isbrandt was closely connected with the earliest work on the die casting of cylinder blocks and other major automotive components. He joined American Motors (then Nash) in 1953 and was appointed to his present position in 1956.

ON THE DIE CAST ENGINE BLOCK

When any part is made as a sand casting, human errors are bound to creep in. It really amounts to making each cylinder block by hand. Naturally, the high direct labor cost is eliminated when the block is die cast. But against this saving, there's an extremely expensive tool steel die. The die for this cylinder block weighs about 40,000 pounds. It has about 225 pieces; about 100 of these are separately water cooled and temperature controlled. Such a die is expensive; the experimental die cost over a quarter million dollars. For a die cast cylinder block to be economical, the saving has to pay for this expensive tooling.

There are, of course, some savings in the machining because the aluminum block is more accurate and more nearly finished as it comes from the die caster. But machining any type of block is so highly automated that even a saving of 50% in labor costs is relatively insignificant.

"IT TAKES A COOPERATIVE APPROACH"

This die cast cylinder block is being made by the Doehler-Jarvis Div. of National Lead Co. This company has had experience in making these large, complex castings since 1950 when they produced the first experimental aluminum blocks.

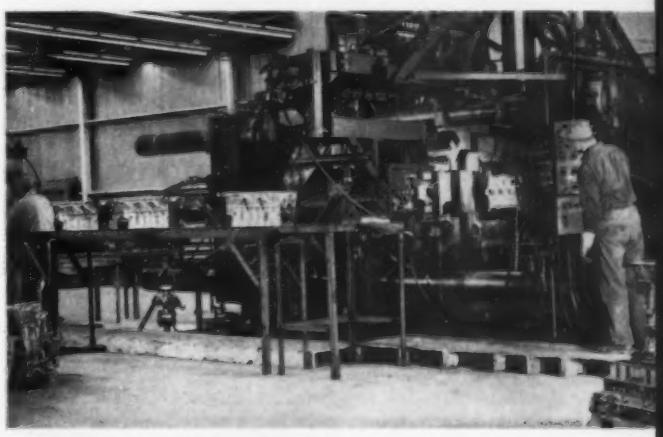
The die casting machines for this job have to be bigger and more specialized than any ever made before.

The design of the block was a cooperative effort between American Motors engineers and Doehler engineers. An engine can be designed and the drawings given to the die caster to "make this". The die caster will come back with an entirely redesigned engine which he can cast. But his design won't necessarily work right. It takes a cooperative approach to get a castable design which functions properly.

The two groups of engineers worked together from the day the program was originated. No cross section or area of the block was developed which wasn't promptly submitted to Doehler engineers for their comments. Any suggested changes to improve the dies and castings were carefully considered by American Motors engineers.

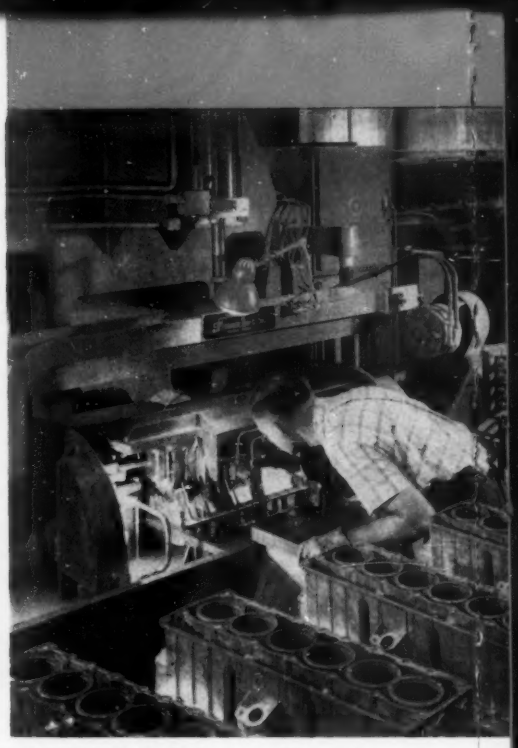
The complexity of the job sometimes made it seem as though the two groups were working at cross-purposes. Development of a cooperative approach brought them into a close liaison, which contributed to the success of the job.

Engine design or quality can't be compromised to die cast it. This, the die caster must understand.



THIS SPECIAL, 2000 ton die casting machine is one of four used to produce die cast cylinder blocks.

CLEANING A CYLINDER BLOCK at the Doehler-Jarvis plant. One cleaning press is used for each die casting machine. This operation cuts machining time.



100% PRESSURE TESTED, that's the type of inspection used on cylinder block. In addition to this test, every cylinder is penetrant examined.

"PRECISION SAND CAST PROTOTYPES ARE USED"

The method of development of this cylinder block is interesting. Rather than produce a set of tools which might work, and then carve at them to get something that actually would work, the first experimental engines were built as precision sand castings.

Hansel, in Germany, is able to produce sand castings which simulate die castings. These sand castings have walls as thin as 5/32" or ⅛". The coring perfectly simulates the cores in die casting.

Through Hansel prototype die castings in the 12% silicon-aluminum die casting alloy were made. Many of the production and design bugs were worked out at a moderate cost so that when the first steel die was designed and built it worked.

Another advantage was production of prototype engines for testing during the 9½ months required to build the die casting dies.

"THE GOAL IS WEIGHT REDUCTION"

The initial goal was to reduce the weight of the engine by from 60 pounds to 100 pounds. A reduction of approximately 80 pounds was made and still further reductions as a result of more development work are possible.

With the weight of the engine concentrated over the front wheels, every pound removed makes for better, easier, safer handling of the automobile.

This new engine will be an overhead valve type. For the time being, it will have a cast iron cylinder head.* Work on a die cast head is going on, but so far not all of the complex coring problems have been solved.

A permanent mold cast cylinder head can be made. The coring problems can be solved easily, but the saving in weight is not enough to compensate for the greatly increased cost of permanent mold castings.

"GALVANIC CORROSION PROBLEMS SOLVED"

A natural question is how about electrochemical corrosion between dissimilar metals. Also how about erosion due to high velocity water flow.

By using a stainless steel head gasket corrosion problems are eliminated. There's no galvanic action between aluminum or cast iron and stainless steel. In other words, the head gasket acts as an effective insulator.

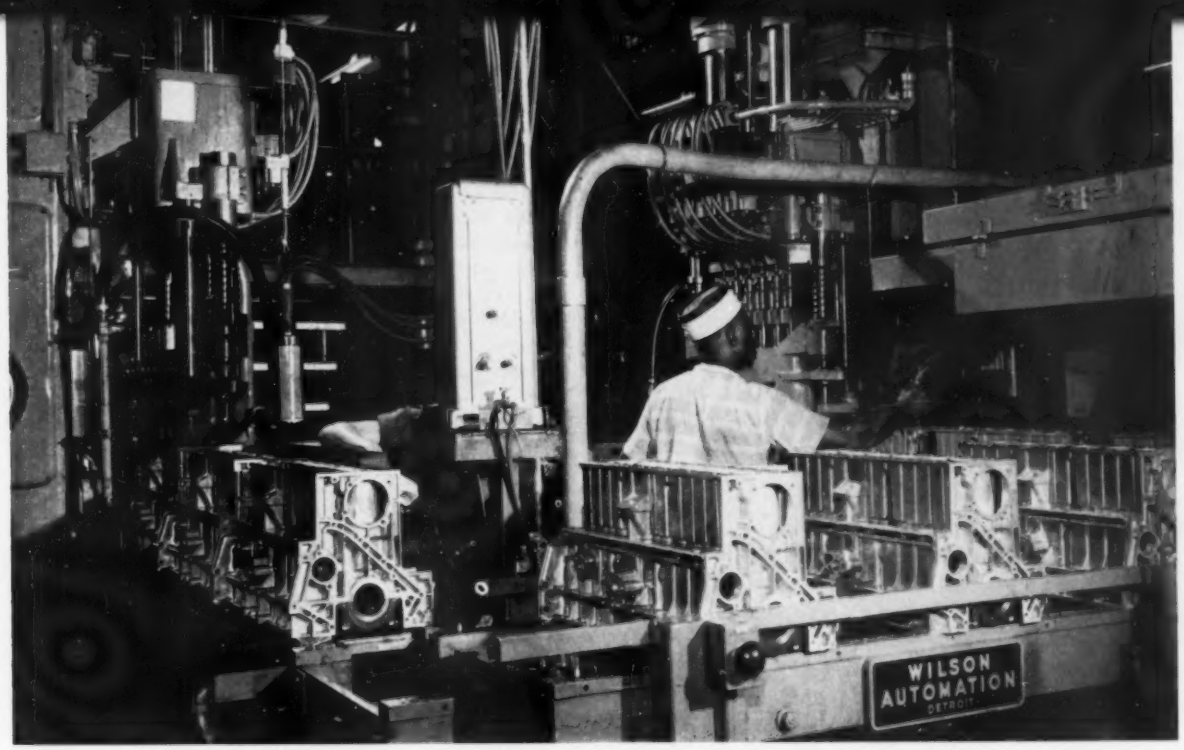
The cooling system has been completely redesigned so that water velocities are low and we have mostly straight line flow.

"CYLINDER LINERS ARE CENTRIFUGALLY CAST"

At first aluminum pistons were run against aluminum cylinder walls. This just didn't work.

The cylinder liners are centrifugally cast iron of about the same composition as piston rings. They are made by the Perfect Circle Co. and are cast-in inserts.*

**The method of casting-in and the advantage of centrifugally cast steel inserts was fully described in* PRECISION METAL MOLDING *in May, 1960.*



AUTOMATIC MACHINING is a must if production schedules are to be met. This line can handle either die cast blocks or cast iron. With die castings fewer stations are tooled up and lighter cuts made, less metal removed.

The iron sleeves are approximately 0.110″ thick and the aluminum muff surrounding them in the water cooled area is about 0.090″ thick.

With this design, piston-to-sleeve wear and wear pattern, fit, and finish are identical to that on the present cast iron block. There's one exception, control of the Brinell hardness in the centrifugally cast sleeve is better because there are none of the variations which are found in making a sand cast block, the placing of cores, chills, and so forth.

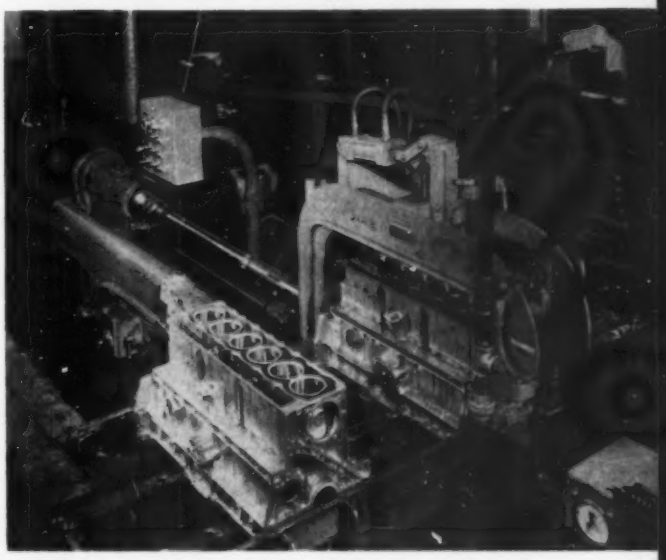
To determine the best sleeve and muff thickness, different types of simulated die cast barrels with iron sleeve inserts were put in a standard V-8 engine. Test runs were made to determine the best combination. The result is a wet sleeve, but it's the aluminum which is wet, not the iron.

The sleeves, with the die cast aluminum muff to give just the barrel portion, were installed in a specially bored block for the test.

Ultimately, different designs were eliminated to arrive at an engine with all cylinders of the same design—the one now used in the die cast block. The difference is that in the production engine barrels are not separate inserts.

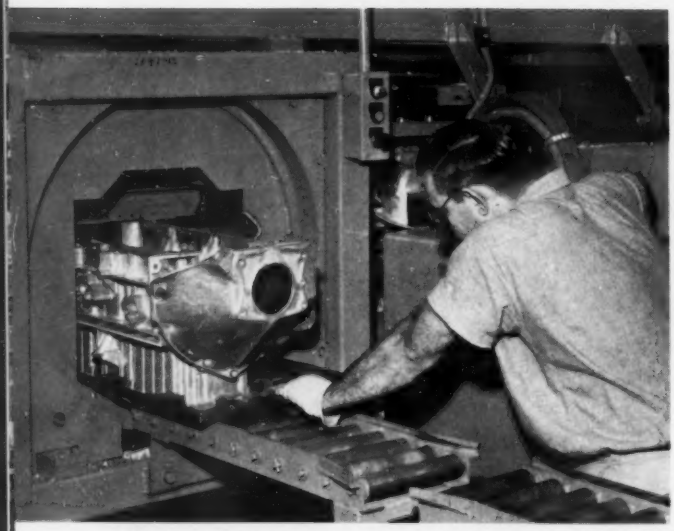
The excellence of bond and the complete absence of trouble due to differential expansion were well demonstrated by test runs in which the entire engine was soaked at minus 40°F to insure uniform low temperature and then started and run up to full operating speed of 1800 RPM immediately.

After 50 cycles of this testing on several engines there were no ill effects at all. This test is far more brutal treatment than the engine will have to take under any owner operating conditions.



"PROPERLY DESIGNED THREADS IN ALUMINUM ARE STRONG"

One of the problems solved in the design of this engine block was adequate strength in threaded holes. By proper control of the form of the tap hole, by using a good thread form both in the hole and on the bolt or cap screw, inserts are not needed. Also, pre-



FINAL WASHING to remove every particle of metal from the block is essential. Then the blocks go to final test (below) where they are checked for accuracy and soundness. Next step is assembly.

waxed cap screws and bolts are used to get pre-lubrication. With these precautions the full torque is used for holding with none used to correct thread form. As a matter of fact, with properly formed threads, a controlled-form tap hole, and the correct proportion of thread to torque, the threads in the aluminum die casting are so strong that a steel bolt will break before the threads will strip.

The machining line for the die cast blocks will be an entirely new one. This is not because the die cast block requires special machining, but because the additional capacity is needed. The new line will be able to handle either aluminum or cast iron blocks.

Probably, the die cast aluminum engine block is only the start of wider use of aluminum in automobiles.

You can do so many things with die castings which can't be done any other way or where labor costs would eat you up if the parts were put together of bits and pieces.

If a grill is designed for die casting, then no other method of manufacture is economically sound. Whether to use zinc or aluminum will depend on the decorative finish wanted and on costs. The big break for aluminum may come when aluminum die castings can be clear and color anodized at a final cost that that is competitive with other materials.

HOW THE BLOCKS ARE MADE

Manufacture of the cylinder blocks is done at the Toledo, Ohio plant of Doehler-Jarvis. There, four specially designed 2000 ton locking pressure die casting machines are running 24 hours a day to produce the blocks needed by American Motors.

These huge machines use 8000 psi pressure on the metal injection. Each shot is 68 lbs. of molten metal, automatically ladled from the holding.

A complete casting cycle is about 2 min.-40 sec., the goal is two minutes per cycle. Of the total cycle time, about 2 minutes are required to open the machine, remove the casting, and prepare the die for the next shot. This time is long because of the excessive lubrication required (there are over 100 cores), and the placement of 9 loose pieces in the die. The die, incidentally, has 7 slides.

The castings are removed from the machine by a mechanical unloader which automatically breaks off the sprue and riser (about 10 lbs. of metal) as the cylinder block is taken from the machine.

From the casting machine the castings go to a cleaning press and then to a final trim press. The cylinder block after final cleaning weighs 56 lbs.

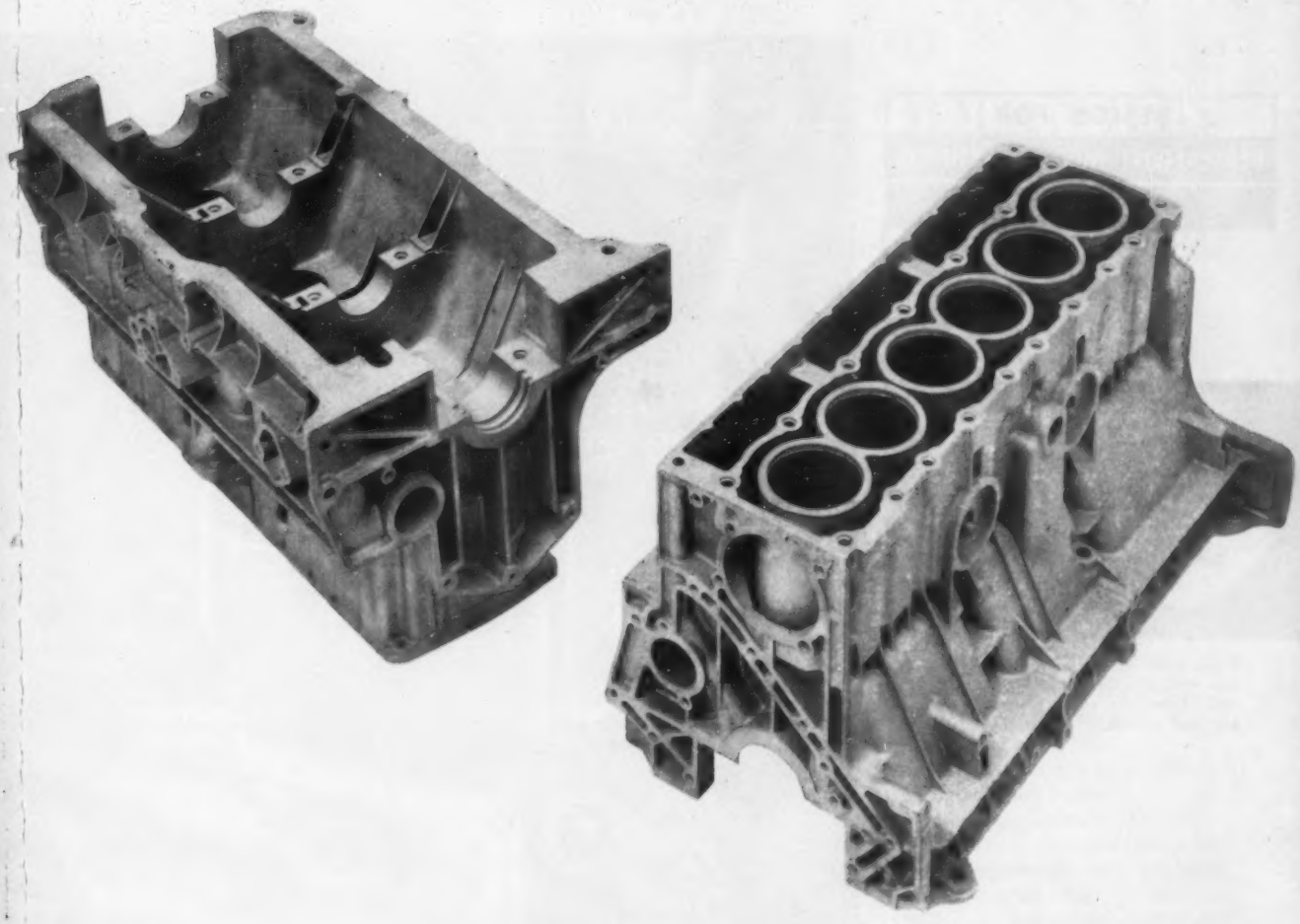
Each casting is pressure tested in both the oil and water circuits. In a final cleaning operation twelve oil holes are cleaned by gang drilling.

There has been some trouble with cracked cylinder liners. Now every cylinder is inspected with one of the dye penetrants to weed out cracked liners.

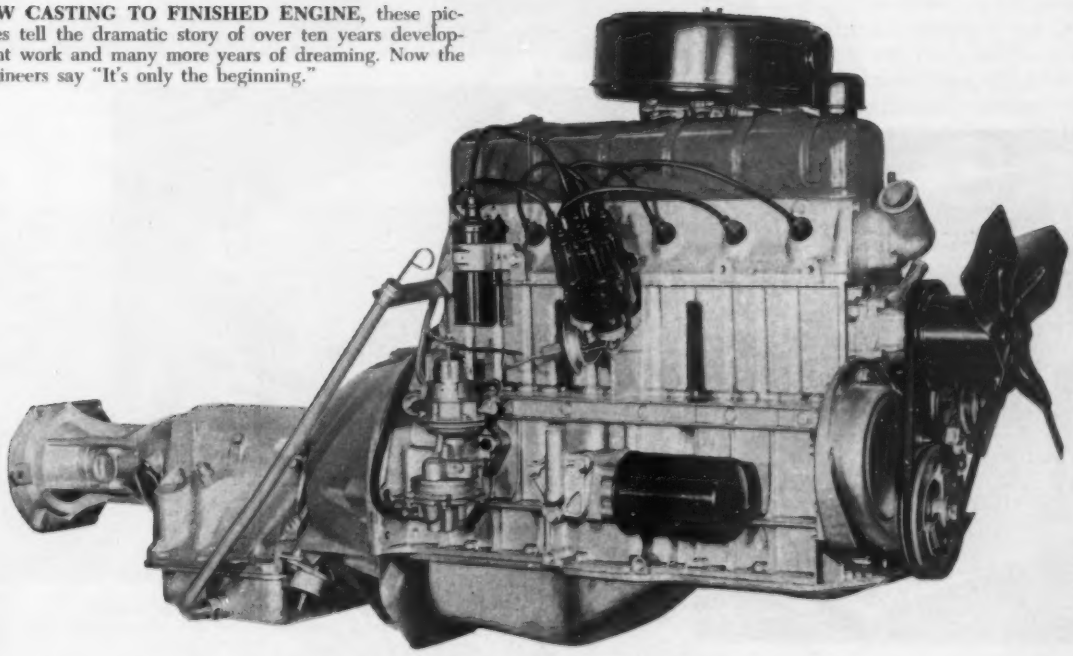
During the development of the die cast engine block it was necessary to check stresses throughout the casting. Such methods as "stress-coat" can be used, but are only one test shots.

A new photo elastic stress measurement method has been developed which allows repeated measurements to be made without removing and reapplying the plastic coating material. With this new method, all parts of the cylinder block where high stresses were set up have been found and redesigned so that no high stress concentrations occur anywhere. An incidental advantage from this testing was that it determined the maximum torque which could be used in tightening the head and other attachments.

While this cast aluminum engine block is a great advance in the die casting art and in engine design, it represents only the first step. New, better, lighter, more economical engines are certain to evolve from this initial work.



RAW CASTING TO FINISHED ENGINE, these pictures tell the dramatic story of over ten years development work and many more years of dreaming. Now the engineers say "It's only the beginning."



DESIGN FOR
PERMANENT MOLD CASTINGS
EXTRUSIONS

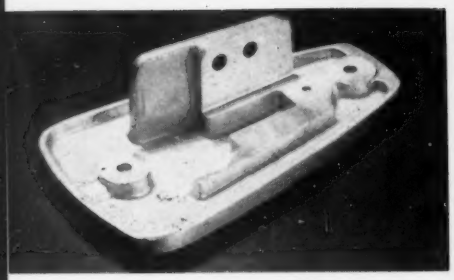
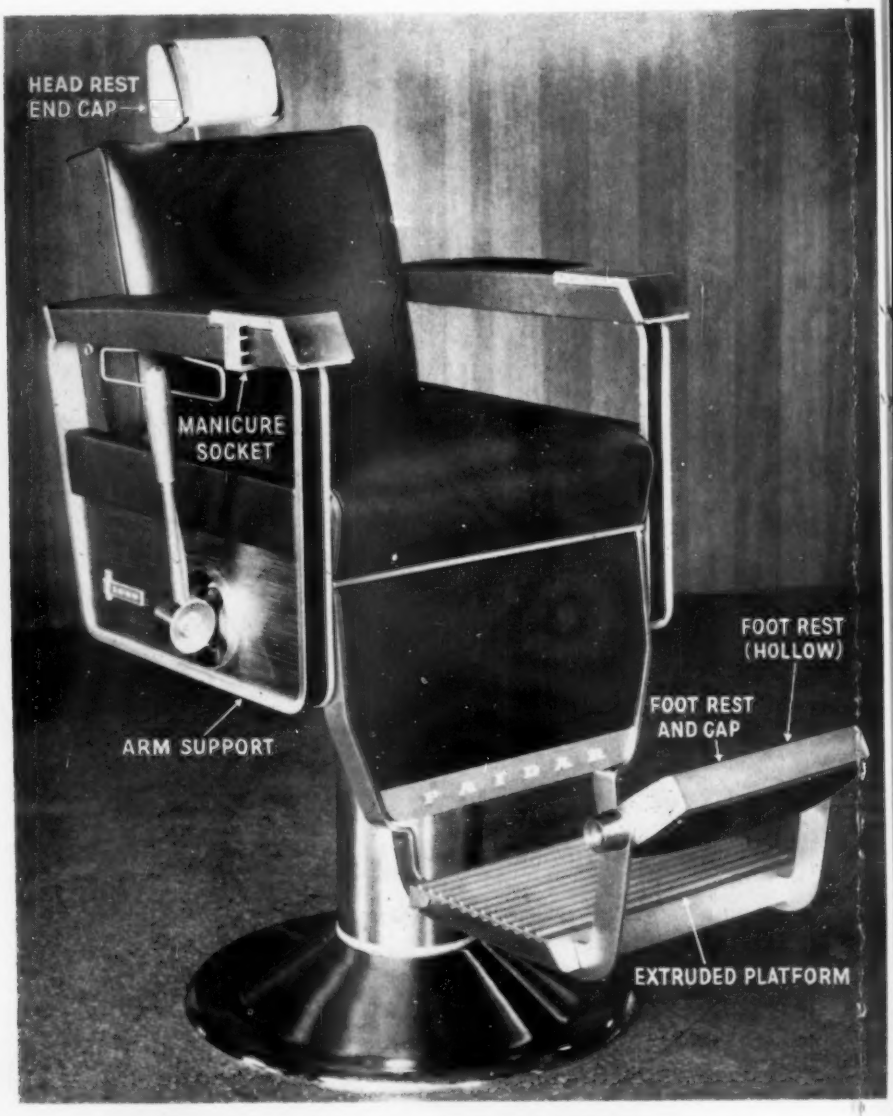
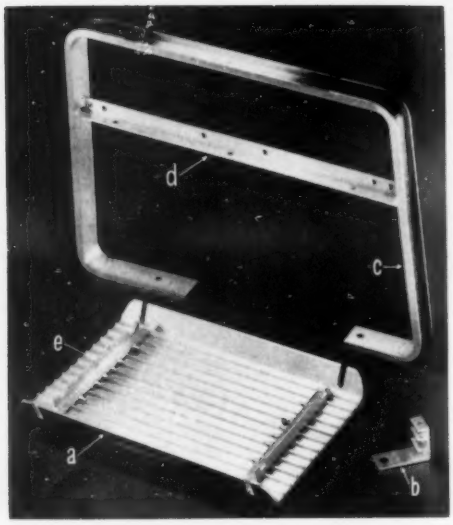


FIG. 1 PERMAMENT MOLD castings are used for the end caps on the head rest. They give rigidity with easy finishing and assembly.





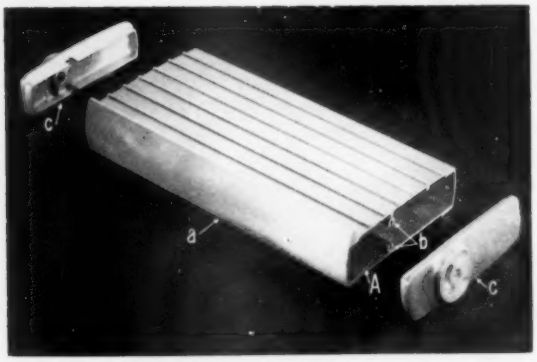
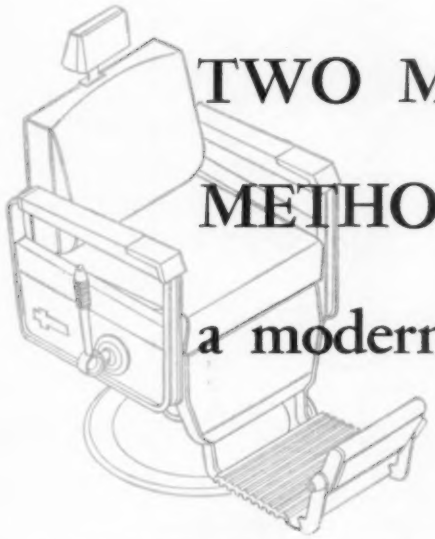


FIG. 2 A COMBINATION of two extrusions and two permanent mold castings make up the foot rest.

FIG. 3 EXTRUSIONS form the basic members for the arm rest and the platform.



TWO MODERN PRODUCTION METHODS TEAM-UP . . to make a modern clean-lined product

By BURTON L. SIEGLE, *project engineer, Paidar Co.*

ALUMINUM EXTRUSIONS are revolutionizing the barber chair industry. The traditional massive, overstuffed barber chair now has the light, low look of contemporary furniture. For the first time, aluminum extrusions and permanent mold castings have been used as main components.

The traditional barber chair, designed around sand castings, had several disadvantages:

- Limited design possibilities.
- Too heavy. The thick walls of the sand castings, required for strength, added unavoidable weight.
- Excessive machining was needed.
- High scrap loss from machining.
- Poor surface finish.

By redesigning for extrusions, the designers not only eliminated the undesirable qualities of the sand castings, they also gained many engineering extras:

- Appearance.
- Light weight. The use of aluminum eliminated as much as 150 pounds.
- No scrap. Properly designed, the only scrap from extrusions is the dust made by the saw blade.
- Low set-up cost. By using extrusions, the company can easily change the model design.
- Color. The ability to color anodize extrusions offers the company the potential of introducing color to a future line of chairs.
- Redesigning enabled the company to combine parts together that used to be separate.
- Assembly time reduced. Output per man has increased by over 450%.
- Uniformity. Extrusions are uniform in shape, and consistent in springback when bent.
- Savings. The manufacturing cost cut 43%.
- Good selling point. Even if the extrusions cost as much as the sand castings they replaced, Paidar would have made the change. The reason is simple. The use of extrusions and a new design gave their salesmen a selling point.

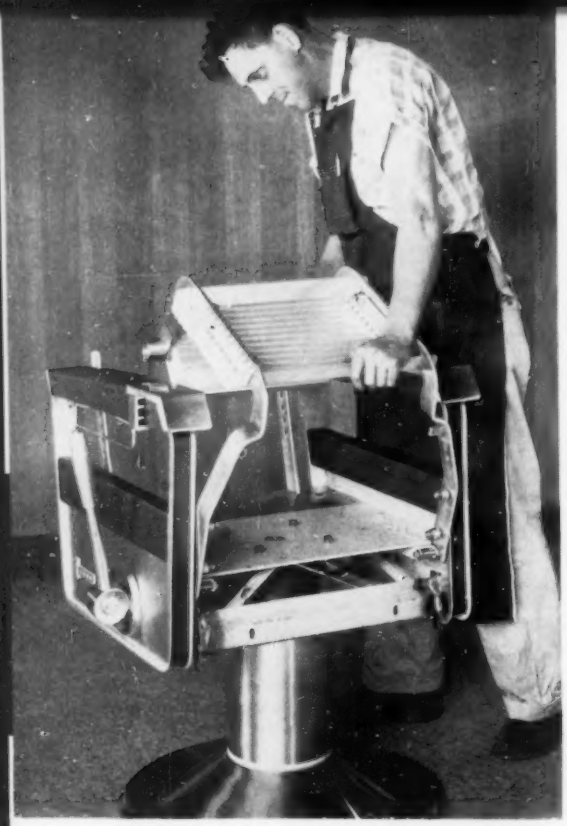
THE EXTRUSIONS

Seven extrusions are used on the Paidar Barber Chair: platform, footrest, manicure socket, arm support, cross member for the arm support, and the platform mounting angle. All are extruded in 6063 T5 Kaiser aluminum by the Bohn Aluminum & Brass Corp.

The cross member for the arm support supports the arm and maintains alignment. The support is heliarc welded in place.

FIG. 4 EDGE BUFFING is all that is needed to smooth out the joint between the extruded sections.

FIG. 5 SIMPLIFIED ASSEMBLY results from the greater accuracy of the extruded and cast parts.



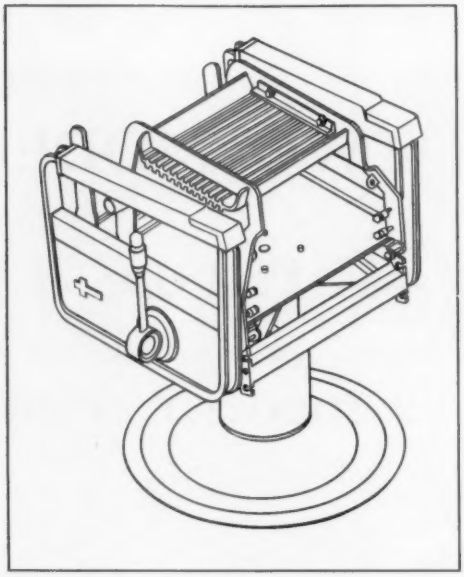


FIG. 6 FINAL ASSEMBLY is no problem. All parts are interchangeable, finish is uniform, fit is good. Only precision formed parts can do this good a job.

The platform is actually two extrusions (same one), fastened together by the platform mounting angle. The two halves are fastened together by heliarc welding the mounting angle in place.

The hollow foot rest, will support a 280 lb. man bouncing up and down on it. The ribs in the extrusion serve the dual function of being decorative and providing strength. The foot rest is extruded to tight tolerances so that the load placed on it is transmitted through the joint with the permanent mold end cap. This also serves to provide a force fit. Two holes, extruded in the foot rest are designed to accept and strongly retain a No. 8 self tapping screw. The combination of the fasteners and the force fit holds the end cap on tight. Surface A, (Fig. 2), is extruded flat to within 0.015. Four holes are drilled in Surface A to accommodate pop-in tubular clip fasteners that are attached to the covered cushion. The advantage is that any color pad can be inserted to match the color of the chair. Then too, the pad can easily be replaced by the barber should it be accidentally damaged.

The extrusions require little machining. After cutting to length, they need only hole drilling. The manicure socket is purchased complete from the supplier.

THE PERMANENT MOLD CASTINGS

Paidar engineers designed the end caps for the foot rest and head rest as permanent mold castings. These are the reasons:

- Dimensional accuracy.
- Good surface finish.
- Suitability for anodizing.
- Can be used as finished. This eliminates extra handling and machining. Sand cast caps would have required costly profiling and finishing.

The only machining needed on the permant mold foot rest cap is to size the center hole. In the early stages of development for the head rest cap, the designers used a sand casting. It had to have five holes drilled in it, and during final finishing they often uncovered pin hole porosity. This resulted in a 25% reject rate. By changing over to permanent mold castings they reduced the weight of the part. And they were able to core the five holes that previously had to be drilled. There has yet to be a reject resulting from porosity. The permanent mold castings are cast in ASTM GZ 42A by the Kellerman Mfg. Co.

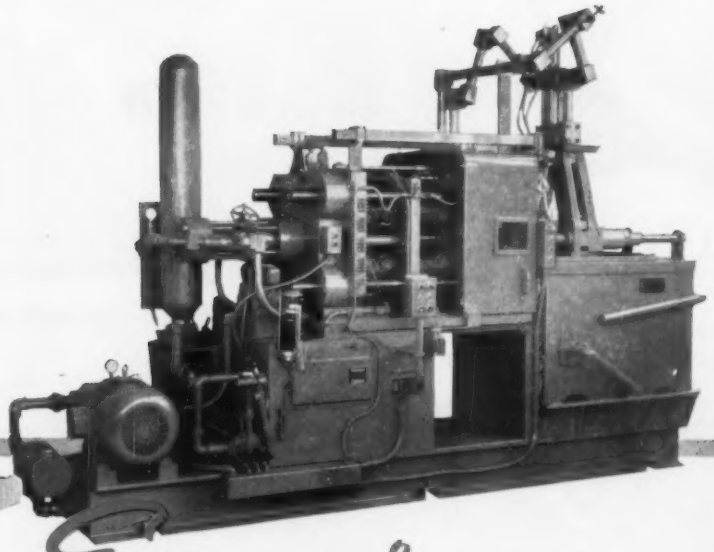
FINISHING

The center of the arm support on the deluxe chair is painted first with a zinc chromate primer, then a dark gray metallic automotive paint. The automotive paint was chosen so that the barber can easily buy touch-up paint if it is necessary to cover any scratches.

The winter months are hard on a barber chair. Salt picked up from the streets and deposited on the platform and foot rest might discolor the aluminum. To prevent this, Paidar gives these parts an extra heavy duty 30-minute clear anodize coat. All other aluminum parts get a 10-minute anodize.

The permanent mold end caps are belt satin buffed on the exposed surfaces. The extruded platform and the foot rest are belt sanded on the sides. Then the insides of the grooves are wheel sanded. The top of the ribs are highlighted with a felt cloth buffing wheel.

GREENLEE-B&T AUTOMATIC ZINC OR ALUMINUM DIE CASTING MACHINES



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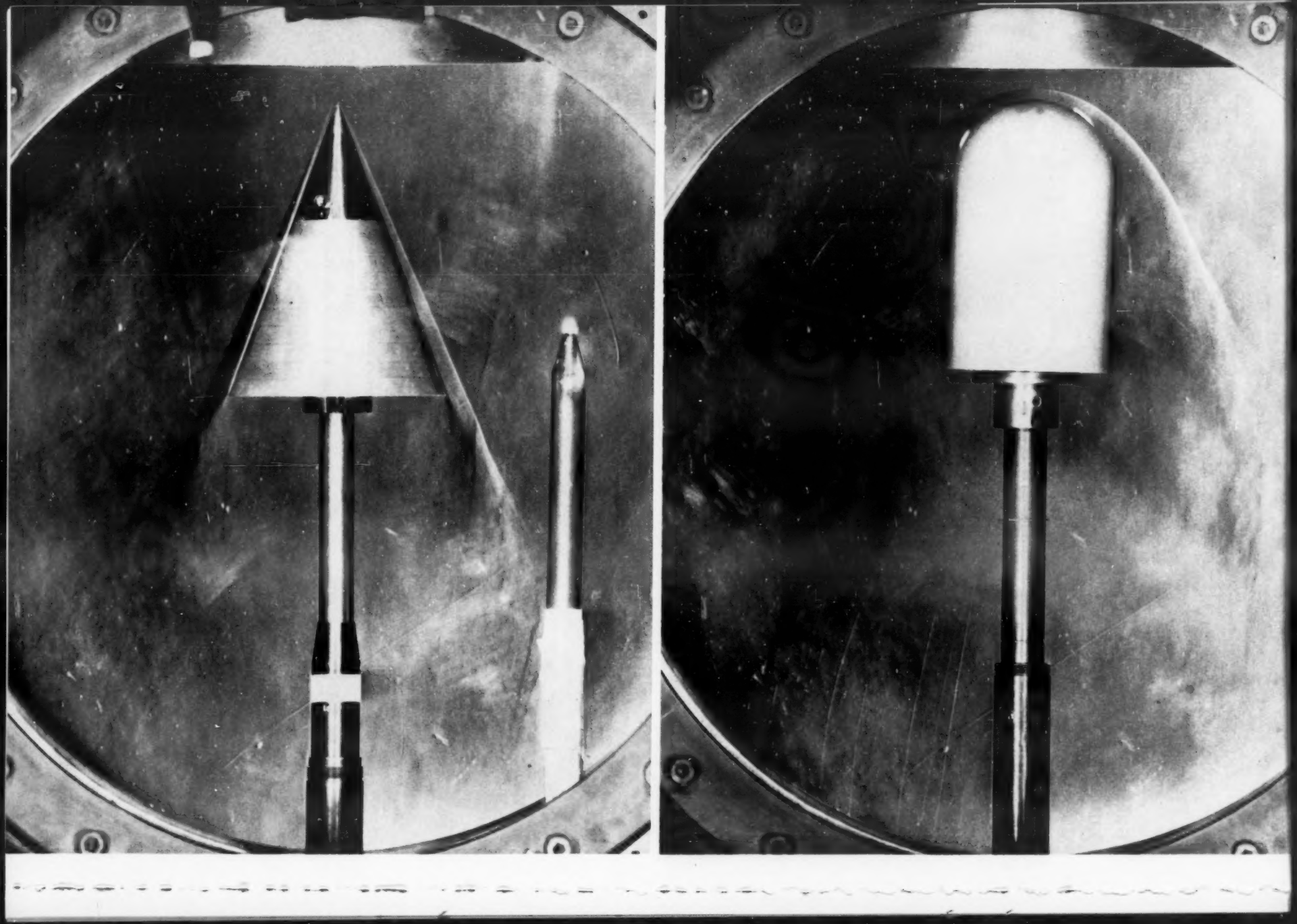


PLASTER-MOLD CASTING MAKES 5-FT HYPERSONIC NOZZLE

. . . Saves tax payers millions

AN ALUMINUM NOZZLE cast by Gorham Mfg. Co. in Providence for the 5300-mph windtunnel at MIT's Naval Supersonic Laboratory is unusual in a number of ways.

Despite its large size and the requirement for extremely precise finish and dimensional control, it was successfully made as a plaster-mold casting. The nozzle, which is shaped like a big cigar holder, is a little over 5 ft long, with a mouth diameter of 2.5 in., necking down to a short throat 0.8 in. in diameter, and opening to a tail diameter of 12.75 in. The surface finish, as cast, is within the 63 micro inches specified by MIT. Because of its shape, it would have been next to impossible to make except as a casting.

The nozzle is designed to be inserted in the throat of an existing supersonic windtunnel, where it doubles the tunnel's speed capability to Mach 7 (5300 mph at sea level), without requiring an increase in the size of the tunnel's air compressors. It will make possible critical testing of future missiles, rockets, bombers and experimental aircraft. With further development, it is expected to produce velocities of Mach 15.

In the past, hypersonic tunnels have achieved their high velocity by brute force, by pushing more air, harder, through the nozzle. This meant larger compressors and bigger heating installations to keep the hugh quantities of air from liquefying as they expanded through the throat.

MIT says its tunnel-in-a-tunnel design accomplishes the same thing for $150,000, compared to millions for the brute force approach. The compressors supply the supersonic outer tunnel (made of wood) with air at normal temperatures. The air for the aluminum hypersonic tunnel insert is supplied by a separate, relatively small system. Only this air is heated (to 1000°F). On discharge, the inner core of air is at a higher pressure than the outer air and rushes toward it, creating the system's hypersonic velocities.

The design of such a hypersonic nozzle is extremely touchy, because of the complex behavior of the airflow at high velocities and temperatures. As a matter of fact, MIT considered it impracticable to supply working drawings or blueprints. Instead, a mass of information was fed into a computer, which came out with a set of 400 coordinates for the dimensions and shape of the nozzle.

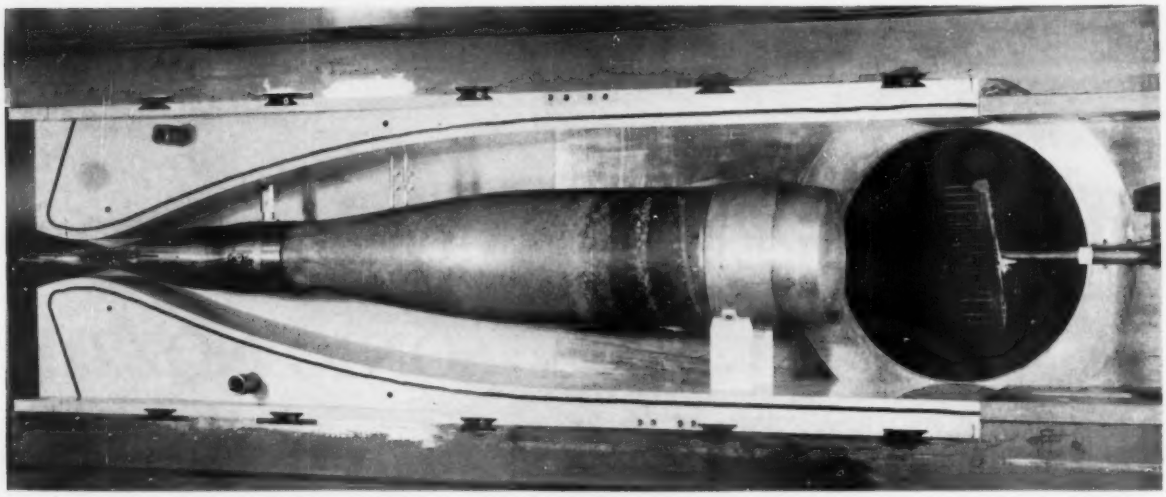
Then, shrinkage coefficients, taking into account the length, diameters and masses of various nozzle sections were fed into the computer to arrive at a set of adjusted coordinates. From these adjusted coordinates, Gorham built a steel template.

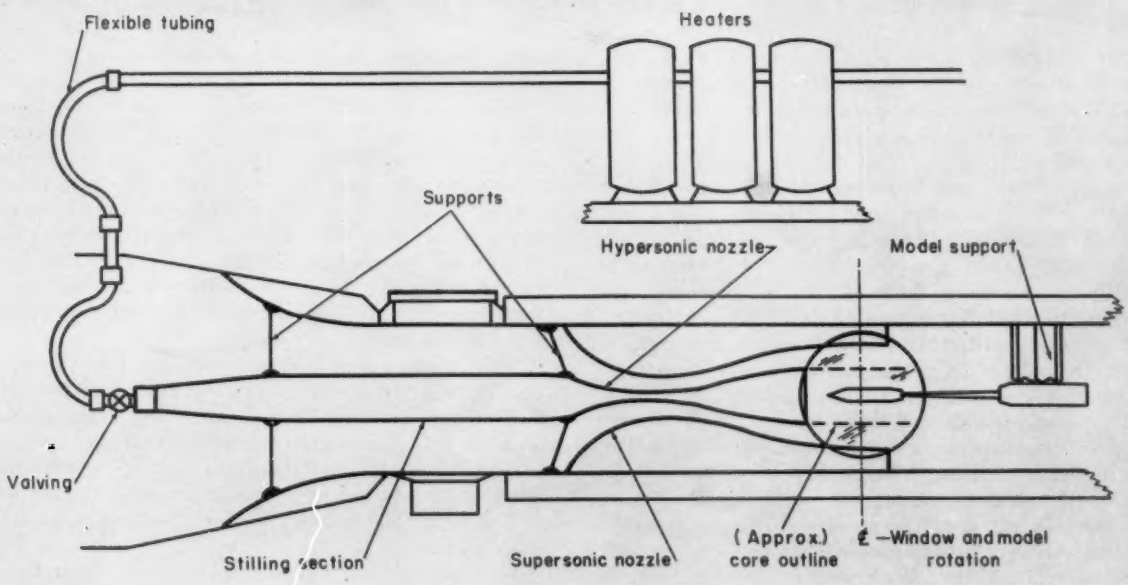
Next step was to make a wood pattern, from which Gorham cast a raw aluminum core stick. This was machined on a contour lathe to the required dimensions. The finished core stick was placed in its wide end and an epoxy mold poured around it. After the epoxy had hardened, it was split and removed. It was then inverted and plaster poured in it. The resulting plaster core required no finishing except removal of the parting line.

The outside of the nozzle is not critical, and the mold for this was made by pouring plaster on a wooden match plate to produce two half-sections.

With the plaster core and outer mold assembled in the vertical position, and with extensive risering, the nozzle was poured. Alloy was 356 aluminum, 325 lb. of which was poured at 1225°F, and later given 51T heat treatment. The finished casting was then ma-

SCHLIEREN PHOTOGRAPHS of an hemisphere and a cone being tested in the hypersonic tunnel. These were calibration tests run to determine the size models which could operate successfully in the tunnel under different conditions. The schlieren system makes it possible to see, with the naked eye, the pressure variations produced in an airstream by an intruding body. At hypersonic Mach numbers the air density is usually so low that only the major disturbances are evident.





MANY MILLIONS of dollars were saved by this aluminum hypersonic nozzle installed between the upper and lower wooden supersonic nozzles (upper illustration. In front of the circular viewing window is a calibration device which measures the air pressure simultaneously at many different points in the test area. This determines the quality of the flow. A model under test would ordinarily be suspended in the same position.
The lower illustration is a schematic view of the hypersonic tunnel system.

chined to final dimensions, a relatively minor operation.

Gorham had expected trouble with the casting, because of its large size, unusual shape and dimensional surface requirements, and the difficulty of supporting the core above the narrow throat. Ed Gotthold, Gorham's foundry superintendent, estimated that it might take eight tries to get a satisfactory casting; but by careful mold design and risering, Gorham was able to ring the bell on the third try.

It took about four months from the time MIT and Gorham opened negotiations on the project to the first successful casting.

Often, unusual jobs like this are one shots and offer little besides the satisfaction of a tough task well done. However, since MIT's success with this relatively inexpensive windtunnel modification, U. S. areonautical research laboratory and an agency of the Japanese government have begun negotiations for similar nozzles.

HOW EXTRUSIONS CHANGE IMPULSE BUYING HABITS

an example . . . Automatic Vending Machines

WHAT makes play fall off on Pinball machines? This was the problem faced by Williams Electronic Manufacturing Co. Their sales were lagging in spite of innovations in mechanisms, cabinet colors, and new types of games.

Samuel B. Lewis, vice president of Williams said, "About a year and a half ago a brain storming session brought up the idea that a New Look might swing sales to our machines.

"We hired Ted Michaels, a Chicago Industrial Designer, to develop several completely new designs for the cabinets which house the games. We chose one of modified size and shape, with tubular metal legs, a pedestal mounted score box, a new top, and new trim.

"The designer preferred the side rails around the game be of aluminum. Williams contacted Aluminum Extrusions, Inc. to figure on the use of aluminum extrusions for the frame. AEI through slight redesign came up with left and right hand rails as extrusions. They also came up with an improved method of top glass installation through the use of extruded aluminum glass channels.

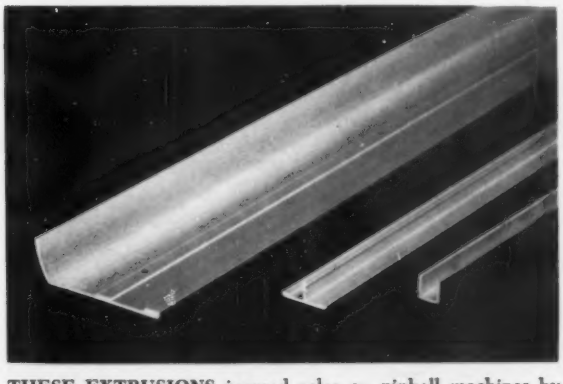
"Altogether, AEI came up with five parts as extruded aluminum sections. They furnish the extrusions of 6063-T6 alloy sawed into seven foot lengths with holes punched, parts sheared, notched, pierced, blanked, formed and clear anodize finished.

"The aluminum extrusions add greatly to the new design appearance and also provide better wear resistance. Refinishing of the machine tops is no longer a major maintenance problem. As an added advantage, aluminum extrusions eliminated the need to metal-line the cabinet to prevent access.

"The result of the new look given by extrusions has been an unbelieveable spurt in sales and machine earnings. In some locations our machines jumped from lowest rank among twenty to a strong first. In another location, sales jumped 50%.

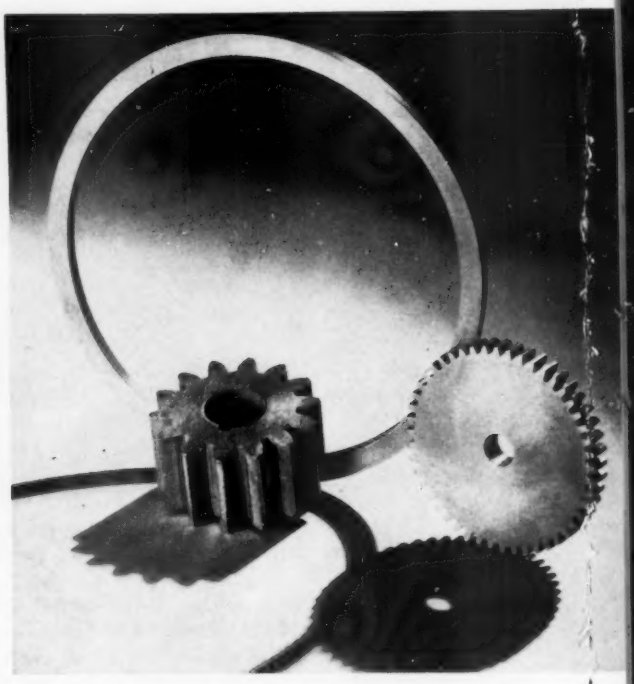
"We believe that aluminum extrusions will play an important part in future design of pinball and similar machines. It's remarkable how inexpensive the tooling is, and that's important on relatively short run models.

"With all our machines, appearance is very important. Judging from our experience with the pinball machine, aluminum extrusions add the final touch."



THESE EXTRUSIONS jumped sales on pinball machines by simply changing the appearance of the cabinet. From old-fashioned to modern was all it took.

Here are the processing data for making . . .



SINTERED NICKEL STEELS/ Part II

By WALTER V. KNOPP, *S-K-C Research Associates, Paterson, N.J.*

VARIOUS commercially available iron powders were used in this investigation. Two of these powders, a reduced and an electrolytic iron powder, were tested under all conditions. The other powders were tested only at a few conditions. The variables investigated were:

Final Carbon Content	0,0.5, 0.75, and 1.0%.
Nickel Additions	0, 2, 3.5, 7, and 9%.
Lubricant	½% Zinc Stearate.
Compacting Pressures	50 tons per square inch.
Sintering Temperatures	2005°F and 2200°F.
Sintering Times	¾ and 1½ hours.
Atmosphere	Dry Hydrogen.

The type of nickel powder used in this investigation was a carbonyl nickel, Grade "B", obtained from the International Nickel Company. The powder characteristics are as follows:

Apparent Density, g/cc	0.90
Flow, sec.	No Flow
Particle Size, microns (Fisher Sub-Sieve Analyzer)	3.10
Sieve Analysis, %	
+100 Mesh	—
−100 +150	Trace
−150 +200	0.4
−200 +270	0.9
−270 +325	2.8
−325	95.9

This powder normally contains about .1% carbon, .2% oxygen, and below .005% sulfur. The fineness, elongated shape, plus the low apparent density of the nickel powder lend themselves to more uniform distribution during blending and better diffusion.

The graphite used for the carbon addition was a natural graphite, (Grade ♯8485), secured from Joseph Dixon Crucible Company.

All the values reported are averages of three test specimens. The carbon values are final values obtained on the sintered test specimens. The tensile bars were checked for the following properties:

1. Green and Sintered Density.
2. Hardness—Rockwell.
3. Tensile Strength—psi.
4. Yield Strength—0.2% Offset.
5. Elongation—% in 1".
6. Dimensional Change on Sintering (in Length of the Test Bar).

Carbon content must be controlled in making any steel. The use of the powder metallurgy technique brings forth an additional problem created by the large surface area of the iron powders. All iron powders contain some oxygen, a factor which must be taken into consideration in determining the amount of graphite to be added to the mix. The higher the weight loss (oxygen content), the greater must be the amount of graphite added in excess of the final carbon. At the same time, the more difficult it becomes to control the final carbon content.

The other requirement for carbon control is a good sintering atmosphere. Dry hydrogen was used in the current investigation. However, other atmospheres can be used with equal success. Factors which must be controlled or eliminated are moisture, CO_2, and CH_4. The first two cause decarburization; the third, carburization. An atmosphere with a controlled carbon potential works extremely well. In using any furnace atmosphere, the furnace must be maintained under controlled conditions and must be loaded uniformly.

Examination of the curves and tables (see PMM Sept., 1960, pgs. 55-61) shows that the increase in time from ¾ to 1½ hours does not increase the tensile strength appreciably. Increasing the temperature, definitely affects an increase in the tensile strength. The yield strengths follow the tensile strength curves. There does not appear to be a great difference between the reduced iron and the electrolytic iron powders tested under all the conditions.

Table 11 shows the results of five iron powders processed and tested under identical conditions. These results are typical. In general, the tensile strengths are approximately the same, with the exception of powder No. 5. This powder has manganese and silicon present, which accounts for the higher values. An interesting fact which shows up in these results is that as the percent weight loss in hydrogen of the iron powder goes up, the shrinkage also increases. The carbon control becomes more difficult as weight loss in hydrogen increases.

Table 9 shows the effect of varying the compacting pressures on the physical properties of one reduced iron powder. As the compacting pressure is reduced, the tensile strengths do drop off.

Since such interesting results were obtained with the nickel additions in the "as sintered conditions", a few exploratory tests have been made to determine the effect of heat treatment. Some of these results are given in Table 10. As one can see, the test bars responded very favorably. For the 2050°F sinter at ¾ hour, as quenched and tempered at 400°F, the tensile strength increased from 78,000 psi to 150,000 psi. The tensile strength doubled with a simple heat treatment.

EFFECT OF VARYING COMPACTING PRESSURES TABLE 9

REDUCED IRON POWDER WITH 3.5 CARBONYL NICKEL + 0.75 CARBON

Atmosphere: Dry Hydrogen — Time: ¾ Hour at Temperature

Compacting Pressure tsi	Density, g/cc Green	Density, g/cc Sintered	Rockwell Hardness	Tensile Strength psi	Yield Strength psi	Elongation % in 1"	Dimensional Change %
SINTERING TEMPERATURE — 2050°F							
30	6.47	6.52	B-68	50,900	41,300	3.3	—0.28
40	6.68	6.73	B-77	61,900	40,600	2.6	—0.42
50	6.87	6.94	B-81	78,000	61,900	4.5	—0.50
SINTERING TEMPERATURE — 2200°F							
30	6.47	6.61	B-77	66,400	47,300	3.0	—0.92
40	6.68	6.80	B-83	71,800	53,000	4.0	—0.85
50	6.86	6.98	B-92	99,900	56,500	2.7	—0.77

EFFECT OF HEAT TREATMENT TABLE 10

REDUCED IRON POWDER WITH 3.5 CARBONYL NICKEL + 0.75 CARBON

Compacting Pressure: 50 tsi — Time: ¾ Hour at Temperature
Atmosphere: Dry Hydrogen

	Density, g/cc	Rockwell Hardness	Tensile Strength psi	Strength Yield psi	% in 1" Elongation
SINTERING TEMPERATURE — 2050°F					
Sintered	6.94	B-81	78,000	61,900	4.5
Quenched in Oil From 1550°F		C-49			
Tempered For 1 Hour					
400°F		C-38	150,000	——	2.0
720°F		C-27	118,000	——	1.7
SINTERING TEMPERATURE — 2200°F					
Sintered	6.96	B-92	99,900	56,500	2.7
Quenched in Oil From 1550°F		C-51			
Tempered For 1 Hour					
400°F		C-43	168,000	——	2.0
720°F		C-32	135,900	——	1.7

TABLE 11 VARIOUS COMMERCIAL IRON POWDERS WITH 3.5 NICKEL AND 0.75 CARBON

Compacting Pressure: 50 tsi — Atmosphere: Dry Hydrogen — Time: ¾ Hour at Temperature

Iron Powders	Density, g/cc Green	Density, g/cc Sintered	Rockwell Hardness	Tensile Strength psi	Yield Strength psi	Elongation % in 1"	Dimensional Change, %	Weight Loss of Powder, %
SINTERING TEMPERATURE — 2050°F								
#1	6.87	6.94	B-81	78,000	61,900	4.5	—0.50	0.16
#2	6.85	7.05	B-78	74,200	47,000	4.7	—0.72	0.32
#3	6.81	6.97	B-87	74,200	68,200	3.0	—0.95	0.63
#4	6.70	6.88	B-80	70,200	57,500	3.3	—1.35	1.11
#5	6.48	6.84	B-84	88,900	69,000	2.5	—2.30	1.26
SINTERING TEMPERATURE — 2200°F								
#1	6.86	6.98	B-92	99,900	56,500	2.7	—0.77	0.16
#2	6.86	7.07	B-78	80,600	57,500	3.1	—0.85	0.32
#3	6.81	7.04	B-88	89,100	80,200	4.6	—1.40	0.63
#4	6.70	6.94	B-84	77,300	63,500	3.2	—1.45	1.11
#5	6.43	6.95	B-90	100,400,	90,600	2.6	—2.75	1.26

THE DESIGN AND USE

Consider Aluminum Impacts When:

1 Aluminum as a material is satisfactory.
2 The length of shell is two or three times the diameter.
3 The part is hollow with one end closed or partly closed.
4 Bottoms have bosses, projections, or recesses hard to form.
5 Zero draft on walls is required.
6 Pressure tight vessels are required.
7 Shapes are too difficult or too expensive to be drawn.
8 Assemblies can be replaced with one piece design.
9 A design modification can eliminate machining operations.
10 Side walls must have internal or external ribs.
11 Heads have changes in section thickness around the circumferance.
12 Quantities are high.
13 Close tolerance, open end tubes cannot be drawn economically.
14 A bottom extending into a flange is required.

For The Best, Most Economical Parts:

1 Use a standard design if one is available.
2 Avoid designs which are not symmetrical around the punch.
3 Make sections in planes perpendicular to the punch axis circular.
4 Specify bottoms which are level inside.
5 Avoid dimensional tolerances closer than really necessary.
6 Keep sections as thin as necessary, no thinner.
7 Avoid gradual radii. Metal flows better around sharp corners.

OF ALUMINUM IMPACTS

By CHARLES H. WRIGHT, *Gen. Mgr., Cliff Mfg. Co.*

ALUMINUM IMPACT EXTRUSIONS are opening new areas to design engineers for light weight, tough, accurate, low cost parts in a bewildering array of shapes and sizes.

VALUE ANALYSISTS are learning to employ impacts where extensive machining, detailed assemblies, and high scrap rates are pushing costs up.

Just a few years ago, the only application of impact extrusion of aluminum was the making of collapsible tubes. Today impact extrusion is a well recognized method of production. It gives forging, machining and deep drawing serious competition. Figure 1 shows a few of the present applications of aluminum impacts and Table I is a more comprehensive listing of the applications of aluminum impacts.

WHAT IS IMPACT EXTRUSION?

When a slug of metal (usually at room temperature) is subjected to impact pressure by interacting tool elements, the metal can be made to flow plastically. This, basically, is impact extrusion.

The flow of metal will continue for as long as pressure is exerted and for as long as any metal remains in the die cavity. By the proper control of the metal flow an almost unlimited variety of shapes and sizes can be produced by single stroke press operations. The main limitation is that the metal must not be stressed to its ultimate tensile strength. The process is broadly classified as forward or backward extrusion or a combination of the two.

BACKWARD EXTRUSION (Figure 2A)

The press punch moves down, exerting pressure on a slug of metal in the die. Metal flows upward around the punch to form a simple shell. The wall thickness is controlled by the clearance between the die walls and the punch. The base thickness can be varied by control of the length of stroke of the punch.

FORWARD EXTRUSION (Figure 2B)

Here the die cavity is provided with a hole of the desired size and shape so that the metal is forced through it by the punch action. There is no clearance between the punch and die walls for metal to extrude backwards.

TABLE I

POSSIBLE APPLICATIONS OF ALUMINUM IMPACT EXTRUSIONS

Aircraft Industry

Landing gear plunger	Airframe Brackets
Accumulator Caps	Pump bodies & parts
Stiffeners	Hydraulic relief valve bodies
Attachment Fittings	Restrictor valve bodies
Hydraulic Pistons	Oil Filter bodies
Reinforcement Fittings	Piston Tube orifice supports

Automotive Industry

Parts for steering	Hydraulic Brake Pistons
Brake and Transmission assemblies	Hose couplings
Oil Filter Cases	Air Conditioning Accumulators

Commercial (general)

Reservoirs	Motor Housings
Valve Plungers	Vacuum Bottles
Grease Guns	Condenser Cans
Door Checks	Food & Beverage Cans
Light Bulb Sockets	Filter Bodies
Photographic Film Cans	Water Filters*
Dictaphone Mandrels	Small Water Tanks*
Giftware	Fittings, water, chemical*
Toy Parts	Magnetic Amplifier core boxes
Vacuum Cleaner Parts	Heat Exchangers
Home Appliance Parts	Capacitor Cases
Foam Rubber Mold Cores	High Pressure, Pump Cylinder
Business Machine Parts	Lightning Arrestor Cases
Hydraulic Lubricator	Battery cases
Calking Guns	Flashlight Cases
Pressure Vessels	Pneumatic Tools
Textile Machinery	Accumulators
Builders Hardware	Air Dryers
Tubes	Cylinders
Electronic instrument cases, housings & shields	Pumps
Tooth Paste Tubes	Hose Couplings

*clad surface

Government

Miniature Motor Housings	Ordinance Parts
Reactor Heat Exchange Elements	Missile Shells
	Satellite Parts
	Proximity Fuses

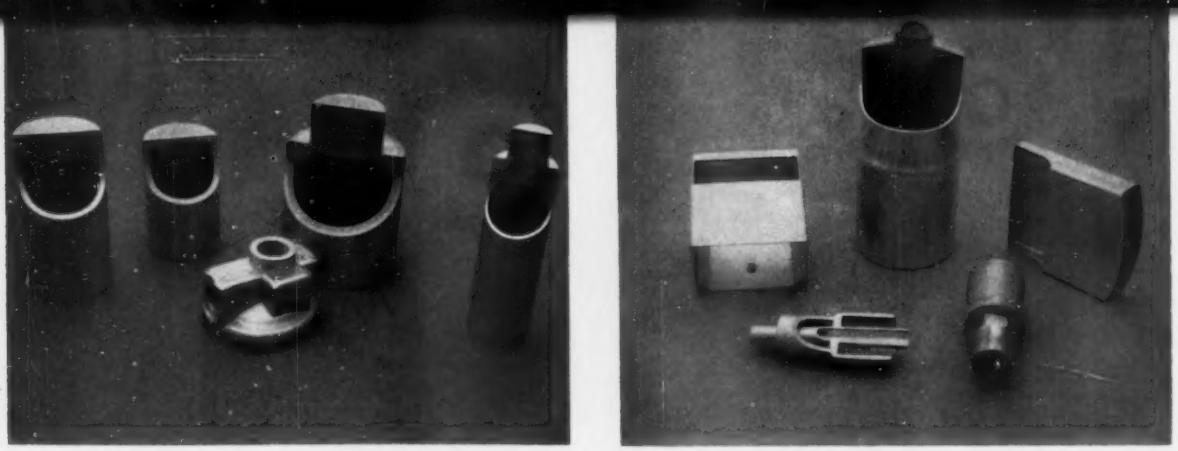


FIG. 1 AN ALMOST INFINITE VARIETY of shapes can be impact extruded in aluminum. These parts show only a few of the possibilities.

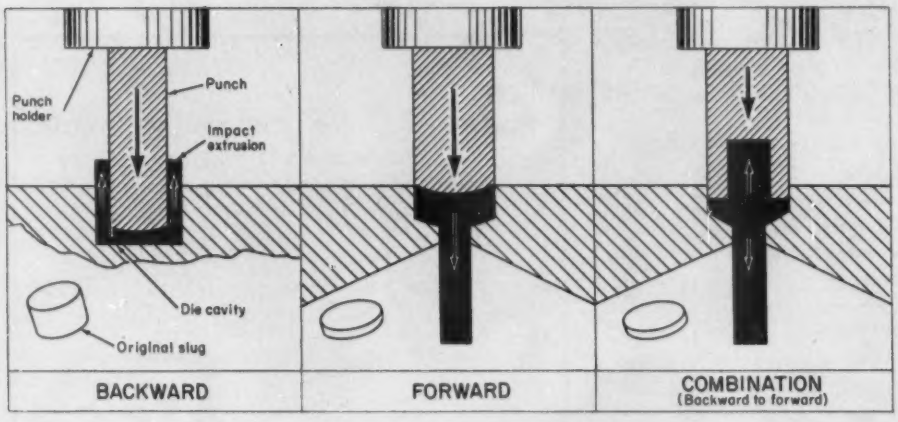


FIG. 2 THE RELATIVE POSITION of the punch to the flow of aluminum is shown for three general types of impact extrusion. As the punch is withdrawn from the die the impact clings to it and is then stripped off.

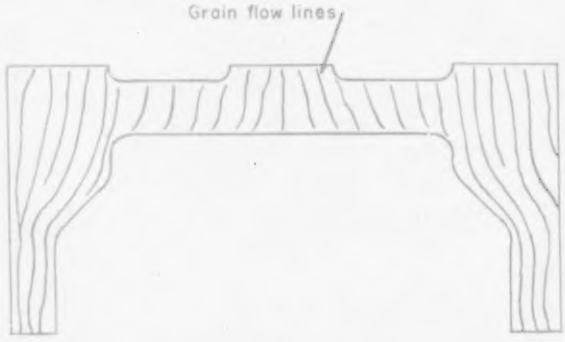


FIG. 3 UNIFORM FLOW of metal during impacting gives a grain structure which is stronger than could be gotten by either casting or machining.

FORWARD & BACKWARD COMBINATION
(Figure 2C)

By putting a cavity in the punch the metal is allowed to flow upward into it until the cavity is filled. Further punch movement causes forward extrusion of the remaining metal.

LATERAL EXTRUSION

A recent development, still in the experimental stage, provides openings in the sidewall of the die. Under pressure, metal extrudes into these cavities. Spoked hubs, for example, are design possibilities of this method.

Table II—Minimum Mechanical Properties of Wrought Aluminum Alloys Commonly Used for Impact Extrusions

Alloy and Temper	Wall Thickness	Tension		Hardness(1)	
		Ultimate Strength Lb./Sq. In.	Yield Strength (Set=0.2%) Lb./Sq. In.	Elongation % in 2" Flat Specimen 1/16" Thick	500 kg. Brinell Load 10 mm. Ball
1100-H152(2)	All	18,000	———	—	—
1100-F(3)	—	———	———	—	—
6151-T6	.040"-.093"	44,000	37,000	7.0	90
6151-T84	All	35,000	32,000	4.0	80
	.094" & Heavier	38,000	35,000	4.0	80
6061-T4	All	26,000	16,000	12.0	50
6061-T6	.040"-.093"	35,000	30,000	4.0	75
6061-T84	All	38,000	35,000	7.0	80
	.094" & Heavier	38,000	35,000	4.0	75
2014-T4	All	55,000	32,000	10.0	100
2014-T6	All	65,000	55,000	7.0	125

NOTES: (1) Hardness applies to bottom of part only. It is only used when it is impossible to obtain a specimen from sidewall for determination of tensile properties.
(2) This temper designation applies only to parts that permit selection of a test specimen from the sidewall and where minimum mechanical properties are specified.
(3) Mechanical property determinations are not required for this temper.

IMPROVEMENT OF METAL PROPERTIES

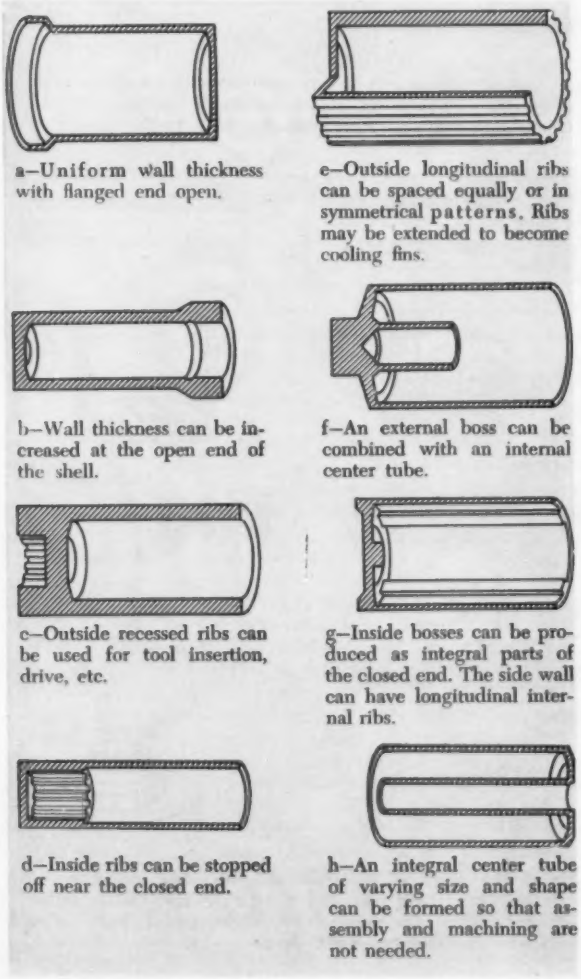
Cold work on aluminum alloys gives properties which are much the same as forging. In addition, alloys which can be work hardened may not need any further heat treatment to develop maximum mechanical properties.

Impact extrusion develops continuous flow lines in the metal which follow the contour of the piece as shown in figure 3. This unbroken fibre flow allows more uniform distribution of stresses and generally results in improved fatigue characteristics. The part shown in figure 3 would withstand bending stresses at the inside corners much better than either a machined or cast part. This is due, of course, to the better metal structure which results from impacting.

Table III—Approximate Minimum Wall Thicknesses for Aluminum Impacts

Diameter of Shell, Inches	Minimum Wall Thickness, Inch	
	1100 Alloy	6151 and 6061 Alloys
¾	0.010	0.040
1	0.010	0.040
1½	0.015	0.040
2	0.020	0.060
2½	0.020	0.060
3	0.025	0.080
3½	0.025	0.090
4	0.030	0.100
4½	0.040	0.125
5	0.060	0.156
6	0.075	0.156

FIG. 4 SHELLS FORMED BY IMPACT can take a wide variety of forms.



a—Uniform wall thickness with flanged end open.

b—Wall thickness can be increased at the open end of the shell.

c—Outside recessed ribs can be used for tool insertion, drive, etc.

d—Inside ribs can be stopped off near the closed end.

e—Outside longitudinal ribs can be spaced equally or in symmetrical patterns. Ribs may be extended to become cooling fins.

f—An external boss can be combined with an internal center tube.

g—Inside bosses can be produced as integral parts of the closed end. The side wall can have longitudinal internal ribs.

h—An integral center tube of varying size and shape can be formed so that assembly and machining are not needed.

WHICH ALLOYS CAN BE IMPACTED?

The most common alloys used are 1100, 6151, 6051, and 2014. Many other aluminum alloys can be extruded but for most applications this group of alloys will give an adequate range of mechanical properties.

The mechanical properties of this group of alloys are given in Table II. The stronger alloys require higher tool loading with consequent shorter tool life and higher production costs. Generally, the stronger alloys are used with heavier wall thicknesses, but each part must be studied individually. The approximate, minimum wall thickness for alloys 1100, 6151, and 6061 are given in Table III.

TOLERANCES & DIMENSIONS

An important advantage of impact extrusion is the ability to hold close tolerances. Walls have no draft and diameters are typically held to ±0.005. Table IV gives commercial tolerances which take into account such factors as tool wear, shrinkage, eccentricity, etc. Parts can be produced to closer tolerances than those given, but only at higher costs. Piece to piece dimensional variations from the same set of tools are slight.

The range of sizes which can be impact extruded is very wide. Closed end tubes have been made up to 8″ diameter, 5′ to 6′ long, and with walls from 0.050″ to 0.5″ thick. The only known limitations on the size of impacts are press equipment and a commercial need for larger parts. Most of the parts now produced are under 6″ diameter and from a few inches to several feet long. Walls start at about 0.003″, though generally they are heavier.

DESIGN SHAPES

While there is an almost infinite variety of shapes which can be impact extruded in aluminum, they can be divided into three general groups.

1. SHELLS (Figure 4)

The basic design is a flat bottomed can (a). This can be varied to give a thickened wall as shown in (b). Bottom thickness and shape can be varied easily. Internal or external bosses provide, wrenching lugs, tubular projections or recesses can all be put on (see c,d,f,g). All these are design possibilitits which can be incorporated in impacts with little extra cost.

Internal tubes can be formed (h). These tubes can be any length, hollow or solid. They may have open or closed ends and can be round, square, rectangular or any other shape desired.

The shells may also be of any shape required. Ribs, fins, or sectioned interiors are possible. Symmetry of the shell is desirable, but not essential. For the more complex shapes alloy 1100 is most desirable and generally recommended.

continued on next page

Table IV—Commercial Tolerances for Standard Design & Round Shells

Outside Diameter	Outside Diameter ±	Inside Diameter ±	Minimum Wall	Bottom ±	Length Outside ±
¾	.005	.006	.005	.007	1/32
¾	.005	.006	.010	.007	1/32
¾	.005	.006	.015	.007	1/32
⅞	.005	.006	.005	.007	1/32
⅞	.005	.006	.010	.007	1/32
⅞	.005	.006	.015	.007	1/32
1	.005	.006	.010	.010	1/32
1	.005	.006	.015	.010	1/32
1	.005	.006	.020	.010	1/32
1⅛	.005	.006	.010	.010	1/32
1⅛	.005	.006	.015	.010	1/32
1⅛	.005	.006	.020	.010	1/32
1¼	.005	.006	.010	.010	1/32
1¼	.005	.006	.015	.010	1/32
1¼	.005	.006	.020	.010	1/32
1⅜	.005	.006	.010	.010	1/32
1⅜	.005	.006	.015	.010	1/32
1⅜	.005	.006	.020	.010	1/32
1½	.005	.006	.010	.010	1/32
1½	.005	.006	.015	.010	1/32
1½	.005	.006	.020	.010	1/32
1¾	.006	.007	.015	.012	1/32
1¾	.006	.007	.020	.012	1/32
1¾	.006	.007	.025	.012	1/32
2	.007	.008	.015	.012	1/32
2	.007	.008	.020	.012	1/32
2	.007	.008	.025	.012	1/32
2¼	.007	.008	.015	.012	1/32
2¼	.007	.008	.020	.012	1/32
2¼	.007	.008	.025	.012	1/32
2½	.007	.008	.015	.012	1/32
2½	.007	.008	.020	.012	1/32
2½	.007	.008	.025	.012	1/32
3	.009	.010	.015	.015	1/32
3	.009	.010	.025	.015	1/32
3	.009	.010	.040	.015	1/32
3½	.009	.010	.015	.015	1/32
3½	.009	.010	.025	.015	1/32
3½	.009	.010	.040	.015	1/32
4	.011	.012	.035	.015	1/32
4	.011	.012	.045	.015	1/32
5	.014	.015	.055	.015	1/32
6	.014	.015	.065	.015	1/32

2. TUBES (Figure 5)

Almost any closed end tubular shape is a possible impact extrusion. All of the suggested shapes shown are made in a single impact operation.

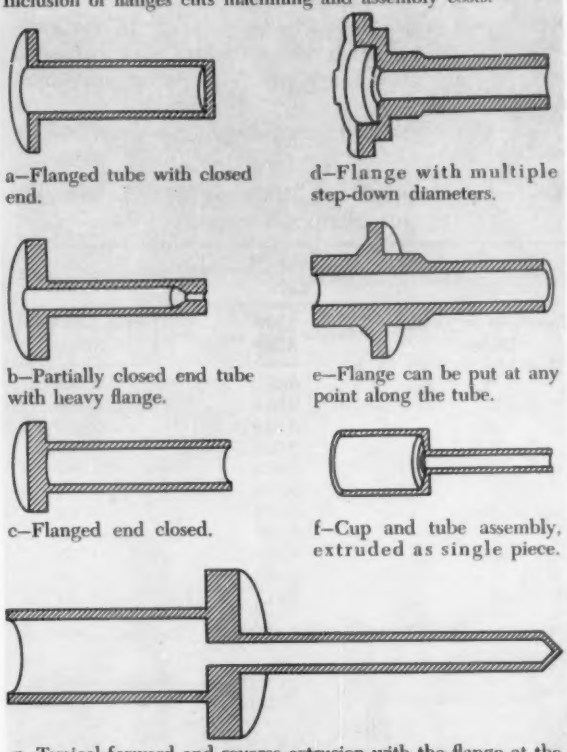
An outstanding feature of impact extrusion is the ability to form a flange at any location along the tube. This can be a single step flange or a multiple step. Tube diameters and wall thickness can vary almost at will. Tube ends need not be flat, both concave and convex ends are made. A cup section can be walled off from the tube if desired.

While the examples shown are all round, this is not a requirement. Both inside and outside shape can be varied to suit functional requirements.

3. MACHINING BLANKS (Figure 6)

For those shapes which can not be extruded to final form it is often economical to impact extrude a machine blank. Where large amounts of metal must be removed to get the basic shape required, it may be possible to start with an impact and avoid both the metal waste and the machining time.

FIG. 5 TUBES, WITH OR WITHOUT flanges can be formed. Inclusion of flanges cuts machining and assembly costs.



a—Flanged tube with closed end.

d—Flange with multiple step-down diameters.

b—Partially closed end tube with heavy flange.

e—Flange can be put at any point along the tube.

c—Flanged end closed.

f—Cup and tube assembly, extruded as single piece.

g—Typical forward and reverse extrusion with the flange at the midpoint. Such an extrusion also serves as a transition from one diameter to another. Wall thicknesses can also be varied.

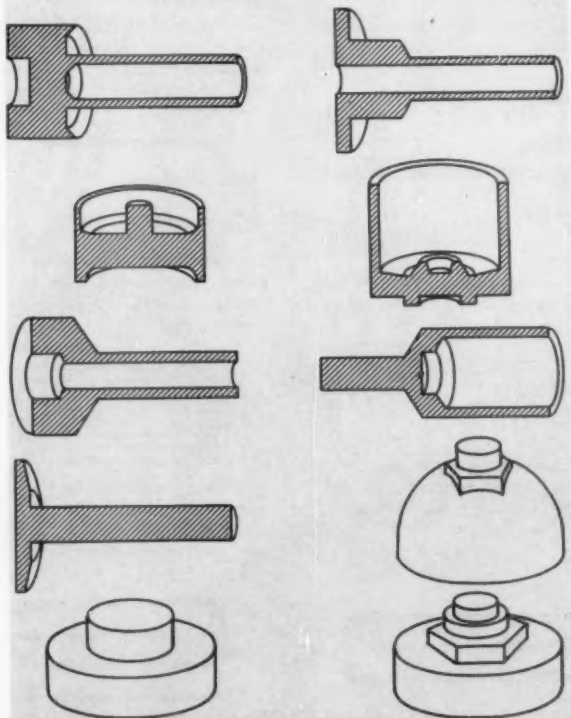


FIG. 6 MACHINING BLANKS made by impact extrusion can save both machining time and material. Blanks can be either hollow or solid. The exact size and absence of draft makes automatic chucking faster and easier.

The examples shown are only a few of the possibilities. Metal and machining time are not the only savings. The absence of draft and the uniformity of impacts makes chucking faster and more accurate. The absence of parting lines, the better grain structure and the initial smooth finish all contribute to the savings possible through the use of impacted machine blanks.

TOOL COSTS, PRODUCTION RATES

Tooling costs for impact extrusion are low. Most tooling can be made in the average tool room with standard equipment. For some tools more elaborate die sinking methods such as spark disintegration may be needed, this raises the tool costs.

At present labor rates our average cost of impact tooling for parts under 3" is from $300 to $500.

Relatively high production rates favor impact extrusion. Average production would be from 1000 to 10,000 parts per month. In this range impacting shows up most favorable when compared to casting or machining from wrought stock. In many cases, the cost of a finished impact may be less than that of aluminum bar stock from which the part would be machined.

When the parts are large and/or expensive as few as 30 to 100 pieces per month might be more economical as impacts than machined castings or machined wrought stock. This is even more true when assembly operations can be simplified or eliminated.

For parts such as flashlight cases, condenser cans, and motor housings production rates up to 4200 pieces per hour can be gotten on mechanical crank presses. For larger parts and impacts in stronger alloys the slower mechanical or hydraulic presses are required.

FINISHES

Smooth surface finishes are characteristic of impact extrusions. The normal range is from 40 to 250 microinches. Parts have been made smooth enough for "O" ring seals in hydraulic equipment without any polishing.

Impacts can, however, be polished to either a bright or satin finish. They can be anodized and dyed, lithographed, painted, lacquered, or plated. Where wear is a factor the Alumilite finish can be applied.

OTHER METALS

While all of the discussion has been with reference to aluminum, other non-ferrous metals can be impact extruded. These include lead, tin, zinc (heated to 300°F), magnesium (heated to 400°F), etc. For special applications impacts in fine silver have been successfully made.

ADVANTAGES & LIMITATIONS

No line can be drawn which limits the application of aluminum impacts. Some of the advantages and limitations are given in Table V.

TABLE V

MAJOR ADVANTAGES & LIMITATIONS OF IMPACT EXTRUSION IN COMPARISON TO OTHER METHODS

COMPARED WITH	ADVANTAGES	LIMITATIONS
SCREW MACHINE PRODUCTS	Internal or external splines, flutes, special cavities inside or outside closed end can be incorporated without costly secondaries. Little or no scrap for deep cavities, and very thin walls, are no problem. Less machining required. High finish without special tooling.	Cannot impact threads. Limited in variety of material to choose from. When no secondaries are involved, can only compete when scrap loss is high. Usually no competition on small diameter parts.
DEEP DRAW	Most economical when draw exceeds two to three times diameter. Bottom thickness can be heavier than side walls. Walls can have stepped diameters. Flanges of varying thickness and diameter can be added to open end, with ease. No draft. Lower tool cost. Less scrap. No subsequent annealing between operations.	Raw material more expensive than flat sheet. Cannot compete with shallow draws.
SAND CASTING	Greater strength comparable to aircraft forging. Closer tolerances, zero draft, no porosity, smooth finish, less scrap trimming and higher production rate. Low labor. Less machining.	Cannot compete on low quantities. Material cost is higher. Projections on inside or outside walls not possible with impact. Irregular shapes are not practical. Size. No undercuts.
DIE CASTING	No machining necessary on long tapered cores, to remove draft. Structural soundness better, no skin effect to contend with. Higher strength, no porosity or brittleness. Strength holds up better under higher operating temperature. Lower tool cost. Better plating surface.	Material more costly. Cannot compete except when secondary machining required or have some structural advantage. Cannot approach multiple cavity production volume.
FABRICATED ASSEMBLIES	Difficult assemblies which require brazing or welding of screw machine parts to stampings, tubing, etc., can often be reduced to a one piece design, with great resultant savings.	Cannot compete on low quantities or extremely large sizes. Limited to shells, tubes and machining blanks.
HOT FORGINGS	Closer dimensional control. Grain distribution more uniform giving better fatigue properties under high stress. Thinner wall sections, withstand higher stresses at reduced weight. Lower tool cost. Better production rates. No trim of flash.	Limited to shells and tubular shapes. Size. Irregular shapes not practical. Projections on inside and outside walls not possible.

COMPOSITE POWDERS / PART I

By J. A. LUND, T. KRANTZ, and V. N. MACKIW

AN ATTRACTIVE approach to many of the problems of compacting and sintering powder mixtures lies in the use of "composite" powders, in which metallic or non-metallic core particles are each coated with a relatively ductile, non-reactive metal.

If each core particle in the composite has a continuous coating and all composite particles are the same composition, then:

(a) No problem of segregation of the components will be encountered;
(b) for a given core particle size, an almost ideal distribution of the components in a compact is possible;
(c) during compaction, interparticle contact and bonding occurs mostly between surfaces of the ductile coating metal; and
(d) reaction of the core component with the atmosphere will be reduced or prevented at ordinary temperatures, and delayed at elevated temperatures.

In the absence of any film between the core and coating in composite powders, the maximum possible contact area will also be assured.

In practice, "ideal" composite powders are not readily obtainable. It is difficult to avoid some agglomeration of the core particles prior to coating, and deviations in individual particles from the average composition of a powder batch. Nevertheless, even an approach to the ideal composite powder is an advantage.

This article describes a study of several nickel-coated metal powders. The powders were made by a hydrometallurgical method developed by Sherritt Gordon Mines, Ltd. The process has been used successfully to coat many metals, carbides, oxides and other substances.

MATERIALS

The compositions and particle size distributions of the elemental powders used in mixtures and as core particles for composite powders in this work are contained in Table I. Similar data for the prepared composites and mixtures are given in Table II.

Core powders (e.g. copper, molybdenum and chromium in the present work) were suspended in an ammoniacal nickel solution containing about 50 g.p.l. nickel, 35 g.p.l. NH_3 and 200-300 g.p.l. $(NH_4)_2SO_4$. The slurry was heated to 350°F in a stainless steel autoclave, and hydrogen was admitted to give a 350 psi hydrogen overpressure. This resulted in the precipitation of nickel metal from the solution on to the surfaces of the suspended core powder particles. The continuity of the nickel coating can be prefected by

TABLE I—Elemental Powders Used in Powder Mixtures and as Cores for Composite Powders

	NICKEL A Fine	NICKEL B Medium	NICKEL C Coarse	COPPER A (1-2 micron)	COPPER B	MOLYBDENUM	CHROMIUM
Purity of Powder	99.7 Ni+Co 0.18 Co	99.8 Ni+Co 0.18 Co	99.9 Ni+Co 0.10 Co	99.7	99.7	99.9	98.4
Screen Analysis (%) +100 mesh	–	–	–	–	–	–	–
-100 +150	–	0.8	100	–	–	–	–
-150 +200	–	5.5	–	–	–	–	100
-200 +250	–	4.8	–	–	–	–	–
-250 +325	–	48.8	–	–	–	–	–
-325	100	40.0	–	100	100	100	–
Apparent Density (gms/cc)	0.86	3.4	4.3	(N.D.)	1.70	1.27	2.5
Source of Powder	Sherritt Gordon Mines Limited					Fansteel Metallurgical Co.	Foote Mineral Co.

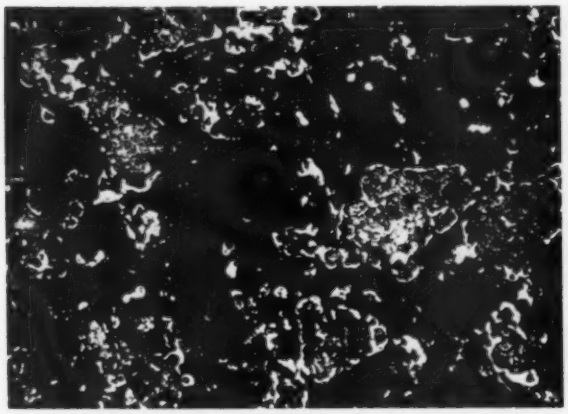


Figure 1 – Composite Powder C1 (Nickel-Copper, coarse).

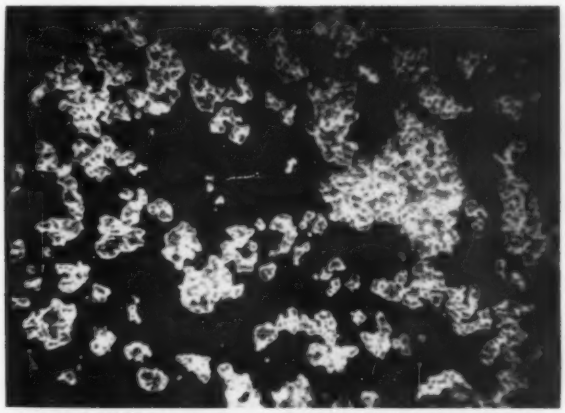


Figure 2 – Composite Powder C2 (Nickel-Copper, fine).

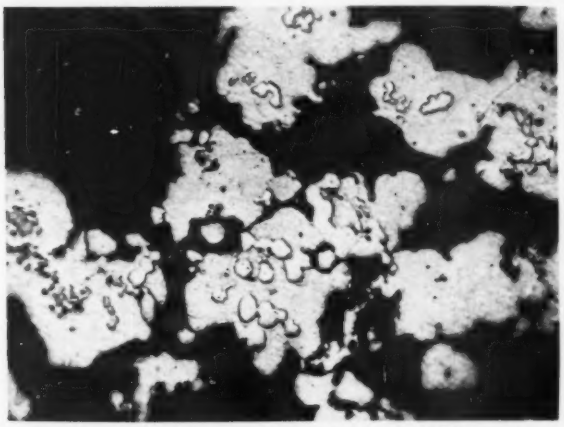


Figure 3 – Composite Powder C3 (Nickel-Molybdenum).

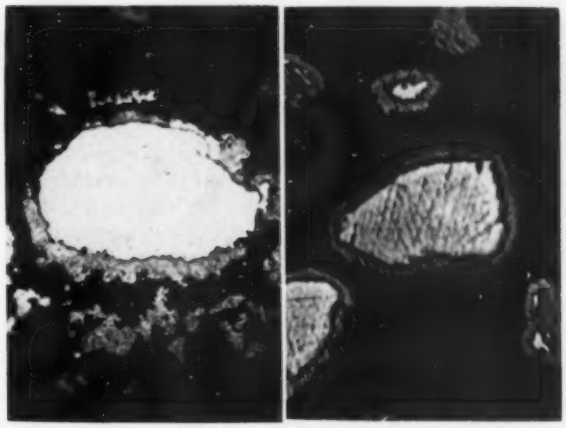


Figure 4 – Composite Powder C4 (Nickel-Chromium).

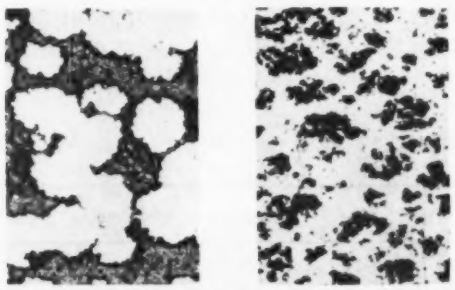


Figure 5A – Mixture M1 (Ni-32 Cu), As-Compacted at *35* tsi. Density 7.27 g/c.c.
Figure 5B – Composite C1 (Ni-32 Cu), As-Compacted at *50* tsi. Density 7.30 c/c.c.

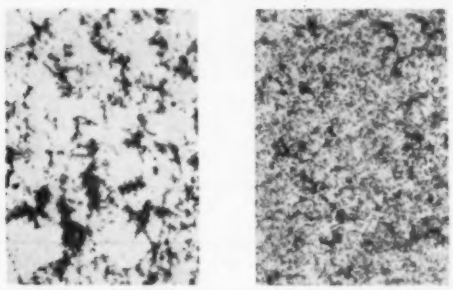


Figure 6A – Mixture M2 (Ni-30 Cu), As-Compacted at *60* tsi. Density 7.23 g/c.c.
Figure 6B – Composite C2 (Ni-30 Cu), As-Compacted at *50* tsi. Density 7.25 g/c.c.

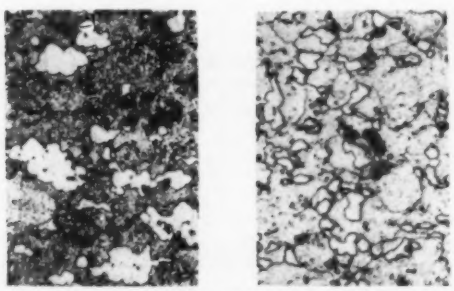


Figure 7A – Mixture M3 (Ni-15 Mo), As-Compacted at *60* tsi.
Figure 7B – Composite C3 (Ni-15 Mo), Compacted at *45* tsi.

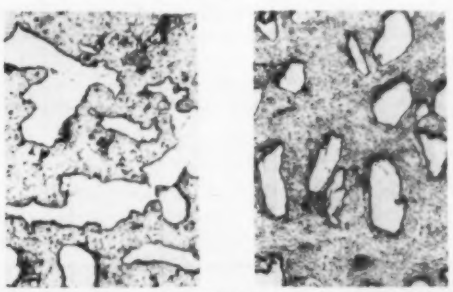


Figure 8A – Mixture M4 (Ni-20 Cr), As-Compacted at *40* tsi.
Figure 8B – Composite C4 (Ni-21.6 Cr), Compacted at *40* tsi.

the use of a very small quantity of a surface-activating agent. In this study no surface-activating agent was used.

The microstructures of composite powders C1 to C4 are shown in Figures 1 to 4. Some agglomeration of the fine copper and molybdenum core particles occurred before coating, so that there was not an optimum distribution of components in the first three composites. The continuity of the nickel coating was near perfect on composite C2. In the other powders, some of the core powder particles were not fully coated. Chromium was found to be particularly difficult to coat uniformly without surface-activating agent. Figure 4(b) shows the structure of a nickel-chromium composite powder prepared using 0.2 g.p.l. of anthraquinone in solution. An almost ideal coating was obtained on all chromium particles by this method. Unfortunately, this refinement in coating technique had not been perfected at the time the sintering studies were made.

The powders used as cores in the composite powders were the same as those used in the preparation of mixtures of equivalent composition. In choosing the most suitable particle size of nickel powder for a given mixture, several factors had to be considered to get a useful comparison between composites and mixtures on the basis of sintering experiments. This matter is discussed more fully in part II of this article.

STUDIES OF SEGREGATION IN COMPACTS

Metallographic examination was used to compare the distribution of components in composite and mixed powder compacts of similar green densities. Two types of segregation have been observed in compacts made from mixtures of powders: (1) that which results from the formation of multiple-particle agglomerates of the components during blending and/or subsequent handling of mixtures, and (2) that which results from the use of component powders of widely different particle size distribution, in which the finer component particles tend to cluster in the interstices between the larger particles.

The first of these effects is evident in the microstructures of compacts pressed from fine mixtures M2 and M3 (figures 6A and 7A), particularly mixture M2. In principle it should be possible to minimize this type of segregation by suitable blending techniques if the components are of similar particle size distribution. In practice, however, handling of a well-blended mixture may result in renewed segregation. The structures of compacts pressed from composite powders C2 and C3 (Figure 6B and 7B) do not exhibit this type of segregation, although some agglomeration of the core particles took place prior to coating.

The second of the effects described above may be seen in the compact prepared from mixture M1 (Figure 5A). It is possible to avoid this form of segregation in mixtures only if components of similar particle sizes are used. Such mixtures have poor compacting characteristics, however. In the case of compacts made from coarse composite powders such as C1 and C4 (Figures 5B and 8B), no segregation of this type is possible, regardless of the range of particle size of the core components.

The component dispersion of mixture M1 could not have been comparable to powder C1 because of the nickel powder particle size distribution. This would have been so even if better blending techniques were used to eliminate the agglomeration of nickel and copper particles.

Comparison of C1 and M1 compacts is therefore justified on a limited basis only. The same argument does not apply to the other three mixtures since the nickel powders used in these cases were substantially finer than the equivalent composite powder particles. *Part II of this report will appear next month.*

TABLE II
COMPOSITE POWDERS AND MIXTURES

		Nickel-Coated Composite Powders				Mixtures of Powders			
		C1	C2	C3	C4	M1	M2	M3	M4
Composition, %		67.1 Ni+Co 31.6 Cu	69.0 Ni+Co 30.0 Cu	84.5 Ni+Co 15.0 Mo	76.4 Ni+Co 21.6 Cr	68.0 Ni+Co 32.0 Cu	70.0 Ni+Co 30.0 Cu	85.0 Ni+Co 15.0 Mo	80.0 Ni+Co 20.0 Cr
Core powder for composites (see Table I)		Copper B	Copper A	Molybdenum	Chromium	–	–	–	–
Powders used in mixtures (see Table II)		–	–	–	–	Copper B Nickel C	Copper A Nickel A	Molybdenum Nickel A	Chromium Nickel B
Screen Analysis (%)	+100 mesh	–	–	–	n.d.	–	–	–	–
	−100 +150 mesh	50.4	–	–	n.d.	68	–	–	0.2
	−150 +200 mesh	13.2	–		n.d.	–	–	–	81.0
	−200 +250 mesh	3.0	–	n.d.	n.d.	–	–	–	1.0
	−250 +325 mesh	4.9	–		n.d.	–	–	–	9.7
	−325	28.5	100	56	n.d.	32	100	100	8.0
Apparent Density (gm./cc.)		3.2	1.9	2.42	2.1	n.d.	n.d.	1.05	n.d.

ALUMINUM DIE CASTINGS FOR HIGH PRESSURES

By WILLIAM J. GRASSBY *Superintendent, Die Casting and Mfg. Div., Bendix Products Div., Bendix Aviation Corp.*

"Our experience shows that die castings are reliable in high pressure applications if:

- **the design is correct.**
- **they are produced correctly.**
- **they are inspected and tested carefully."**

HUNDREDS of thousands of aluminum die castings are used in automotive braking systems where internal pressures are around 1000 psi (and occasionally 2000 psi) without leakage or failure.

People who don't trust die castings in these applications usually say that the casting porosity cannot be controlled. Experience at Bendix shows they are wrong. Porosity, especially microscopic porosity, cannot be eliminated. But proper procedures and testing eliminate unsafe and leaky castings without adding much to the cost. Of their advantages, we find that die castings:

- meet service requirements
- can be produced rapidly.
- are low cost.
- look good.
- are light weight.

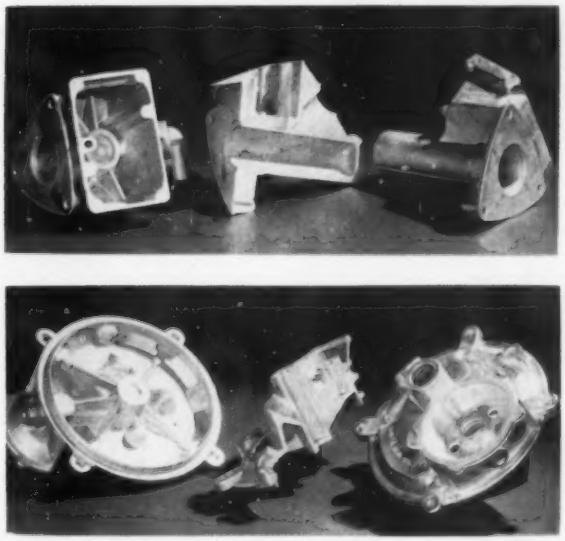


Figure 1. SOME of the high pressure aluminum castings produced by Bendix Products Div. for use in automative breaks. These parts have been impregnated and machined. Ribbing adds greatly to their stiffness. The sectioned casting shows almost no porosity.

ALLOY & DESIGN CONSIDERATIONS

Bendix uses secondary aluminum alloy 380 for their die cast brake components because it combines good cast-ability with ample strength. Also, it permits casting at moderate temperatures favorable to long die and furnace life.

We once tried a similar virgin alloy but found that it soldered to die parts and provided no advantages although it cost more.

Our designers try to keep the casting sections as uniform as possible. They avoid sections thick enough to encourage porosity, and use ribs where more strength and stiffness is needed.

PRODUCING THE CASTING

It's important to use top notch machines and dies when you're trying to get good high pressure castings with low rejection rates. Also, pressures, temperatures, and the selection of the cycle for each casting design are important. A highly rigid die casting machine insures proper die locking.

Injection pressures in our Lester Phoenix cold chamber machines come close to the 23,000 psi they were designed for. The maximum pressure in each cycle is held for as little time as needed to get a good casting. Short, high pressure dwell helps reduce maintenance costs on hydraulic units, especially piston pumps. Impact force in the machine is 22,000-30,000 psi, depending on shot plunger diameter.

Each machine provides automatic control of the complete cycle. All conditions, including metal and die temperatures, are held as nearly constant as possible.

Also, automatic ladling in this application would be worth the large investment it would require.

DIE DESIGN

Sturdy, well designed, and well built dies are also essential for the consistent production of sound castings. All our dies are made from air hardening die steels. So are the shoe or holder in which removable cavity blocks are fastened. All core pins are nitrided after hardening for long life and reduced maintenance costs.

All the dies are stiff enough to withstand the high locking and injection pressures without flexing enough to cause excessive flash or spitting. This is safer for employees and insures that the metal is subjected to full injection pressure. It also produces castings of low porosity, insures complete die fill, and practically eliminates large voids.

We make liberal use of overflow wells in the dies as shown in figure 2. Overflow wells reduce the eddies and the amount of aid trapped in the casting. Examination of metal flow lines usually shows the best position for overflows and vents. Other than that, there is no rule in locating them to best advantage. We use trial and error placement until good results are obtained.

All cores must be locked securely since they are subjected to the high injection pressures.

All dies have ejector pins operated automatically as the dies open.

IMPREGNATION

Studying impregnation methods has permitted us to establish set-ups which are semi-automatic and have very low labor costs. One man can operate the whole impregnating set-up at a rate of 1,500 to 2,000 castings in eight hours. Two men will double the output. Impregnating cost is below 7¢ per casting, not including testing.

Castings having flaws too severe to seal by impregnation are scrapped and remelted. These average below 4%.

To be impregnated, batches of 500 castings are sealed in an autoclave. Then they are subjected to 29.5″ Hg vacuum, which is reached in 6 minutes. They are held at this pressure for 14 minutes to purge air from exposed pores.

Heated impregnant is admitted and circulated for 20 minutes at 100″ Hg above atmospheric pressure. This forces the solution into pores where chemical action produces oxides. The oxide produces a metal-to-metal bond whose strength increases progressively over several months, but the pores are sealed permanently in the 20 minute process.

After impregnation, castings are rinsed in cold water and put through a conveyorized washing and drying machine. The sealer is easily washed off exposed surfaces, but no amount of washing removes the sealing oxide from the pores.

It is best to allow castings to stand 24 hours after impregnation before subjecting them to high pressures.

TESTING

Hydrovac brake assemblies are put in fixtures (figure 3) and tested at 1000 psi for 30 to 40 seconds. An assembly is rejected if pressure drops during this time. After the timed test, the pressure is raised to around 2000 psi to make sure the brake assemblies can take abnormally high loads.

An automatic test stand for Treadle-Vac brake assemblies is shown in figure 4. It tests the units at 2500 psi. If there is leakage, the casting is rejected.

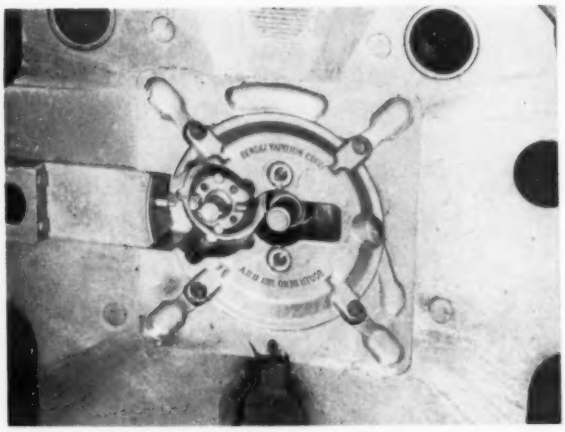


FIG. 2 COVER HALF of a die for casting an aluminum end plate for a Hydrovac power brake. Six overflow wells help avoid porosity.

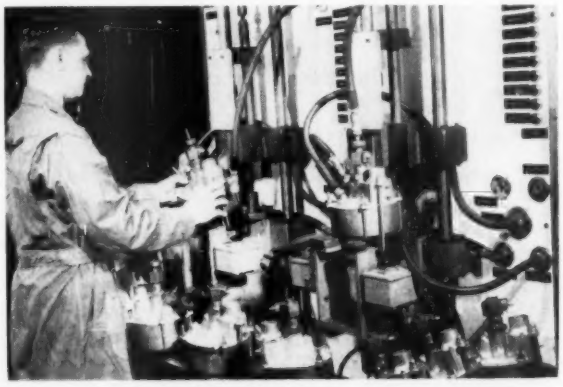


FIG. 3 TWO-STATION machine used to test Hydrovac break assemblies at a pressure of 1000 psi. Stations are used alternately, one being loaded while a test proceeds in the other.

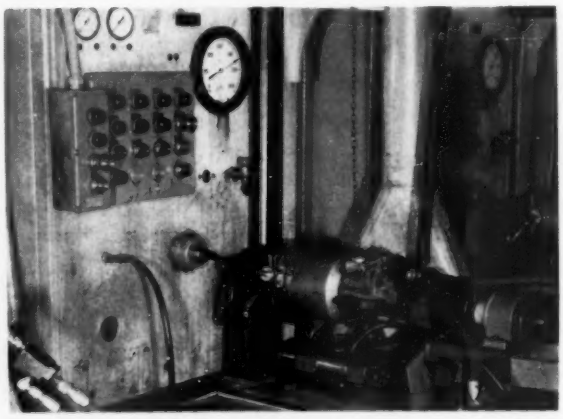
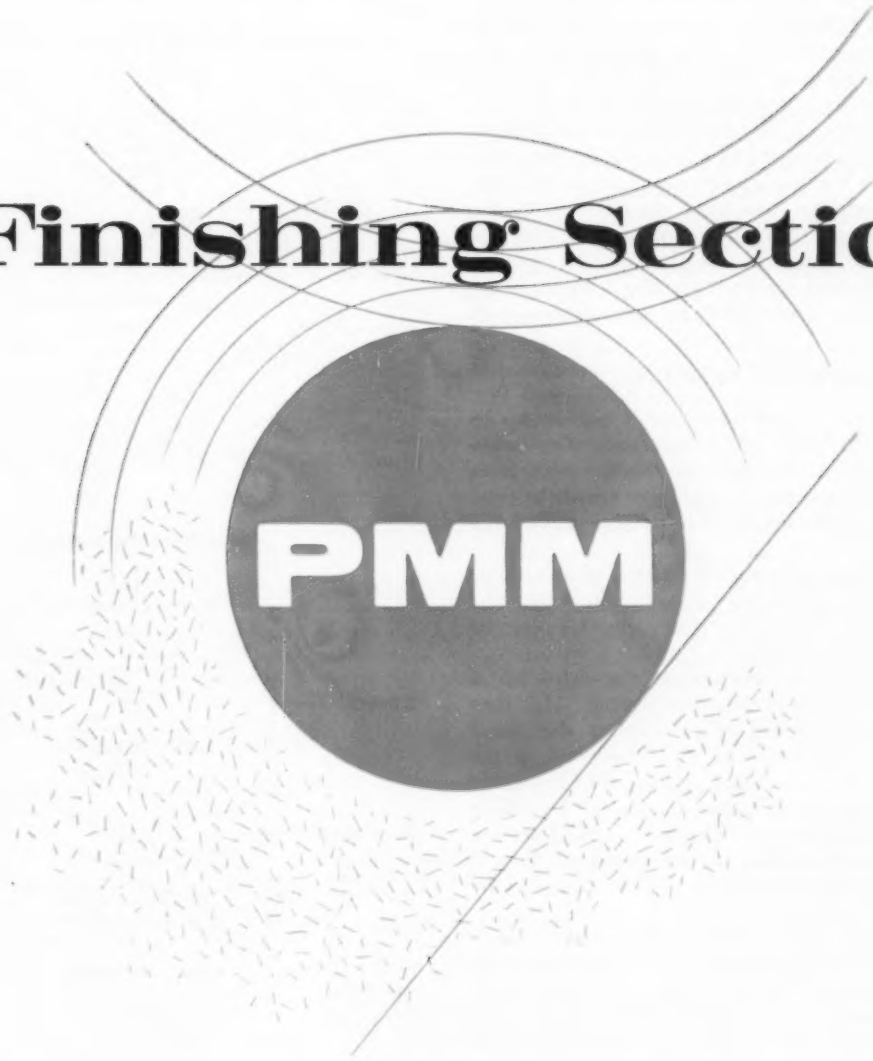


FIG. 4 TREADLE-VAC break assemblies are pressure tested to 2500 psi. on this automatic testing machine. If the unit leaks a red light flashes.

The specialized finishing methods, equipment and materials used to machine, assemble, surface condition or surface coat precision metal molded parts are presented here. This includes all secondary operations which convert a raw casting to a finished product.

Finishing Section



BENDING EXTRUSIONS .....Page 62

HOW TO FINISH 2½ MILLION PARTS PER YEAR .....Page 64

Complex shapes from simple ones by . . .

BENDING EXTRUSIONS / Part I

MORE DESIGNERS are finding that they can get the complex shapes they need by bending extrusions. This fabrication method makes many of their products more attractive, more functional, and easier to make and assemble. Not only do they get design advantages, but it's usually the lowest cost way to get the job done.

Although the bending process appears simple, the bending method and technique greatly effects the complexity and cost of tooling, care necessary in production, and the properties of the finished product. Table I lists general information about some of the bending methods. These methods are illustrated in figure 1.

METAL REACTION TO BENDING

When metal is bent, tensile stresses are set up on the outside of the bend, and compressive stresses occur on the inside. At the point on the extrusion cross section where the stresses change from tensile to compressive, there is no stress. This point is called the neutral axis.

If the metal fibers are stressed into the plastic range, they keep some permanent deformation when the stress is removed. That is why the piece stays curved when it's bent far enough.

There is a flow of metal when the extrusion is stressed by bending into the plastic range. This flow causes a thinning of the outer wall as the metal stretches and a thickening of the inner wall as the metal compresses. This thinning does not necessarily weaken the structure because the metal has been cold worked in the process. The cold worked section in the bend sometimes has a greater strength than it had before bending. This effect can be cancelled by annealing after bending.

The metal flow causes another effect during bending. It is sometimes great enough to cause puckering on the legs of bent channel sections or other areas having large metal displacement. This can be controlled by tight die tolerances and relieving portions of the die to accept the displaced metal.

CONTROLLING METAL FRACTURE

If the ultimate strength of the metal fibers is exceeded during bending, the part will break, form micro-cracks, or other undesirable effects. Here are some of the ways to correct this:

- Make a smaller bending angle.
- Make the bending radius larger.

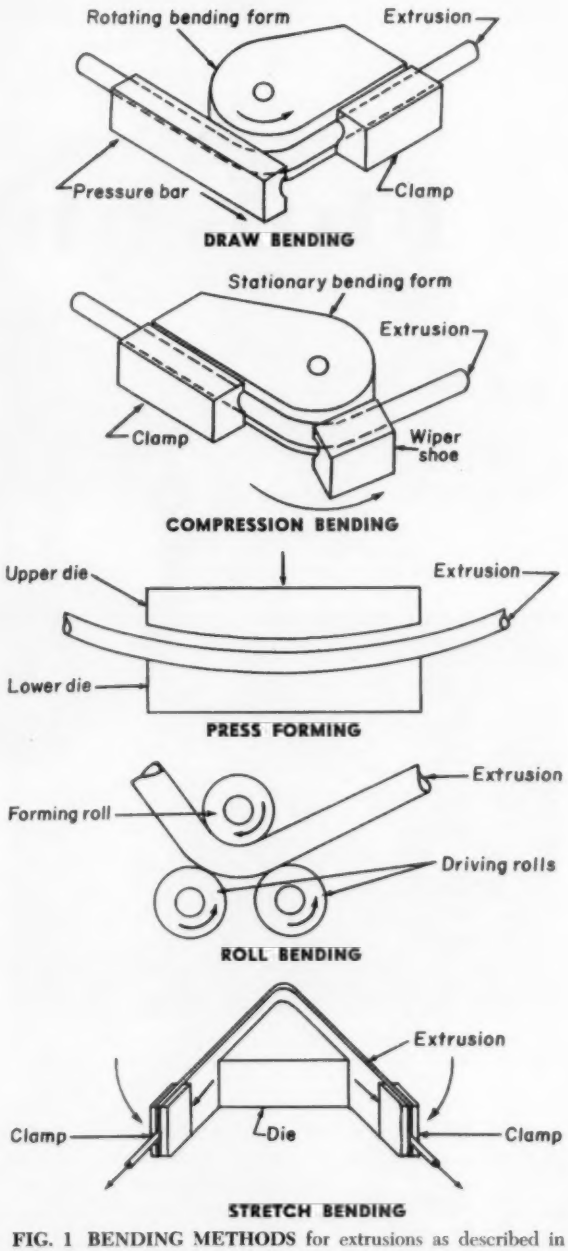


FIG. 1 BENDING METHODS for extrusions as described in Table I.

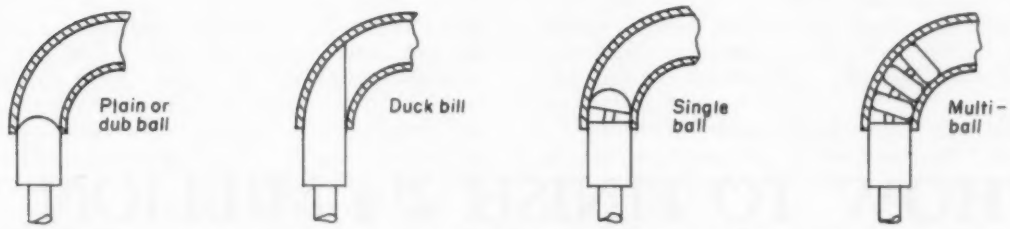


FIG. 2 MANDRELS are used to support hollow shapes during bending. Multi-ball mandrels are used with severe bending operations. Plain mandrels are used where bending is not severe.

- Select an alloy with more ductility. 1100-0, 3003-0, 5050-0, and 3003-0 alloys with elongations of 25% to 35% will be easier to bend than tempered alloys.

However, unsatisfactory results may be due to the tools or technique. For example:

- Forming too rapidly
- Improper tool design or alignment
- Improper clamping of material
- Improper press operation
- Improper lubrication.

The choice of lubricant is usually important in bending thin walled sections. The type of operation (see Table I) and severity of bend determines lubrication requirements. A water soluble paste is usually satisfactory for medium bending. A viscous oil is needed for heavy bending.

INTERIOR SUPPORT

Since hollow or channel sections tend to collapse or warp during bending, mandrels are needed to support these sections. The plain and duck bill types are used in bending heavy sections. Ball type mandrels are used for thin sections. Various mandrels are shown in figure 3.

DESIGN ANALYSIS

In order to analyze the stresses and loads resulting from bending, don't use conventional straight beam theory. In a curved bar, bending produces a parabolic stress distribution, not a linear one.

The neutral axis moves away from the centroid of the section toward the inner surface as curvature is increased. It is generally assumed to be one third the section thickness away from the inner surface. The reader can refer to strength of materials or theoretical elasticity text books for the theoretical determination of neutral axis location, stress magnitudes, and stress distribution.

Material for this article was contributed by Kaiser Aluminum & Chemical Sales, Inc.

TABLE I

TYPE	PROCEDURE	APPLICATION	COMMENTS
Draw Bending	The extrusion is clamped to a die. The die is rolled along the extrusion, picking it up and forming the extrusion to the die surface, much the way dough would stick to a rolling pin.	Usually used for thin walled sections, especially where the extrusion is sharply bent.	Cold working usually increases section strength at the bend even if the bending operation is severe. Each increment of the extrusion is bent at the same place on the die. Therefore, a mandrel inserted at that point will provide all the support needed. Usually requires lubrication.
Compression Bending	The forming die is stationary. One end of the extrusion is clamped to the die, then a wiper shoe moves along the extrusion and presses it down to the contour of the die.	Used mostly in making large radius bends not less than three times the extrusion thickness.	There is less cold working and wall thinning here compared to draw bending. Mandrel arrangement is difficult. Sometimes requires lubrication.
Press Forming	The extrusion is bent by being pressed between two dies in a press similar to a stamping operation.	Mostly used in making only slight bends.	Mandrel is usually a simple, leaf spring type. Usually does not require lubrication.
Roll Bending	Bending roll presses the extrusion down between two driving rolls.	Can produec sharp bends or full circles in a continuous operation.	Mandrel arrangements are difficult. Usually does not require lubrication.
Stretch Bending	Extrusion is locked in two holding clamps. It is then stretched over and wrapped around a stationary die.	Best suited to thin, sheet-type extrusions or heavier sections not requiring mandrel support.	Wall thickness reduction runs to 40% of elongation, but greater uniformity of metal properties result. Usually requires lubrication.

HOW TO FINISH 2½ MILLION PARTS PER YEAR

HOW WOULD YOU SURFACE FINISH 2½ MILLION small parts per year? That's a lot of surface finishing, and when most of them have to look like chromium plated parts the job becomes tougher. Now, just to make it really rough, all of these parts are gift and novelty items which depend on impulse buying, so this finishing method must be very inexpensive.

David Products Co. faced this particular headache. They turned to vacuum plating for the answer.

Metals (mostly zinc base die castings) and plastics have to be surface finished and in some cases must match. That is, an assembled novelty item may be composed of both die castings and plastic parts. The entire assembly must have a uniform finish and paint or lacquer won't do. The only answer is vacuum plating.

THE IDEA

Now, what's the genesis of a gift or novelty item? First, of course, some one has to have a bright idea. Many of them come from Tom Davis, president of the company. Others are ideas from outside people who submit them to the company, and still others come from the sales force who see what is selling.

HOW ABOUT DESIGN?

Given the idea, the designer starts to work. He must create an attractive product with sales appeal, of course. But he must also design for very low cost manufacturing. Let's suppose that the new product is going to be die cast. In addition to designing for the casting process the engineer must remember that

TYPICAL vacuum plated small zinc die castings.

the part will be vacuum coated. Therefore, means have to be provided for racking on the spiders which go into the flow coater, the drying oven, and the vacuum tank. What's more, the cost of racking is so high that it can only be done once.

Then too, there is the question of high-lights. The position of the part on the spider will determine where the high-lights will be on the finished novelty. The designer must decide this in advance to determine his mounting method.

The type of surface is another important factor. Smooth surfaces require buffing and polishing. But the biggest part of the saving from vacuum plating is the elimination of these operations. Therefore, practically all novelties are made with broken surfaces which require no surface preparation.

Very frequently component parts are separately finished and then assembled. Here the thickness of the surface finish must be remembered. Generally there are two layers of undercoat and one of overcoat. The total thickness is about 0.004". Masking to prevent coating where a fit is required is too expensive, so the casting must be made to permit assembly of fully finished parts.

WILL IT SELL?

The proof of this pudding is in the selling. No company can afford to make many thousands of items that don't sell. Davis Products always does market testing. The new novelty is made first as a zinc slush-casting. Tooling costs for this method are low and production of other items is not interrupted to make a few hundred pieces. These slush-cast parts are completely finished and sent out to dealers. Both buyer and dealer reaction is determined and if the new item appears salable then, and only then, full scale production starts.

Unit dies are used to hold tooling costs down and all dies are made in the company tool room. After casting and trimming, the material passes to the finishing department.

VACUUM FINISHING

Cleaning

Degreasing is the first step. Vapor degreasing has proven the best method up to now. It leaves the surface clean and free of all shop soil. No surface treatment such as a chemical conversion coating, prior to lacquering is needed since the service life of the finish is short.

After degreasing the parts are racked on specially designed spiders. It is important here that the utmost care be taken since the parts will not be removed from the spider until the finish is completed.

Undercoating

The first step in vacuum finishing, after racking, is to apply the lacquer undercoat. The lacquer is applied by flow-coating and generally two coats are required with only air drying between. After coating and air drying, the racked parts are baked at 325°F. for 45 minutes. The purpose of the undercoat is to level the surface so that surface defects which would

RAW PARTS are mounted on spiders at the beginning of the finishing process.

cause rejects in plating, for example, are covered and smoothed out. This is, incidentally, the reason for using flow coating rather than spray coating. With spray coating a uniform layer of lacquer is applied, while with flow coating the layer can vary to eliminate minor surface irregularities and defects.

In some cases, however, the smoothing effect of flow coating is not desirable. For example, on pivots and axles of rotating parts the flow coater would build up. For such parts, spray coating is used.

Davis has three flow-coaters. Each can apply a lacquer coating to a rack of parts in about 30 seconds. A rack full of parts which must be spray coated will require about 5 minutes per rack.

After flow-coating the racks of parts are placed on rotators which spin the racks at 10 to 12 rpm to even out the lacquer and aid the drying. From 10 to 15 minutes are required to complete this operation.

Undercoat Baking

After air drying the loaded racks go into an oven for baking the undercoat. Six racks are loaded on a single truck for the baking operation. Two ovens, each holding four trucks are used. Baking is one hour at 300°F.

Vacuum Coating

After the undercoat has been baked the parts are ready for vacuum coating. This coating, or plating, process depends on the deposition of aluminum from the vapor state on a cold surface.

In the vacuum chamber, the spider carrying the parts to be plated is arranged so that it can be rotated around a horizontal axis. At the axis is a series of heating elements, coiled tungsten wire, on which small clips of pure aluminum and, in this case ribbons of foil, are hung. When the spider and the heating elements with their charge of aluminum, are in place the vacuum chamber is closed and evacuated to a pressure of 0.3 microns.

After the pressure is down, power is applied to the heating elements to melt the aluminum so that it coats the filaments uniformly. The filament temperature is then raised and the aluminum evaporated. During evaporation, atoms of aluminum radiate in straight lines in all directions from the filaments. Wherever the vapor contacts a cool surface it condenses. This cool surface may be the parts to be plated, portions of the spider, or the inside walls of the vacuum chamber. Time for evaporation and condensation is extremely short; probably milli-seconds. When evaporation is completed filament power is turned off, the vacuum broken with outside air, and the chamber opened.

Total time for the plating operation depends on the relative humidity of the air. At 50% relative humidity, the cycle requires 25 minutes. However, at 90% relative humidity, the time is 45 minutes.

In this plant the flow coating and plating are done in the same room. There's a fairly high concentration of lacquer-thinner vapor in the air so it is not safe to admit it to the vacuum chamber. Outside air is, therefore, used. A new set-up is planned where the vacuum coater will be in a separate, fully air-conditioned room so that the almost 2 to 1 time variation due to humidity changes will no longer apply.

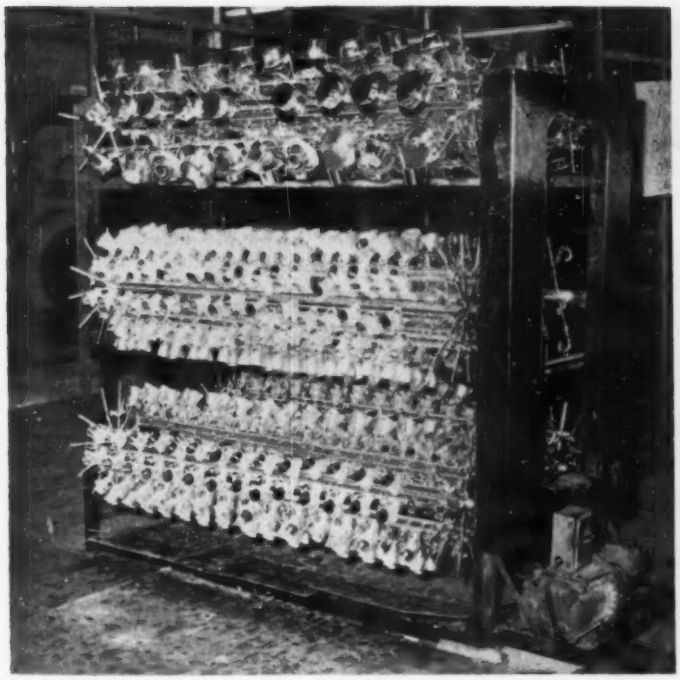
Another factor which influences the pump-down time is the accumulation of aluminum on the tank walls and on the spider. A peelable strip material is used to coat the inside of the tank and every three weeks it is removed and the tank cleaned. A new coating is put on after cleaning. This cleaning cycle is about longest which can be allowed without running the pump-down time excessively long.

One of the major cost factors in vacuum coating is the tungsten wire heating filaments. Generally from 14 to 16 shots can be made per filament.

Overcoating

When the parts are removed from the vacuum chamber they have a brilliant surface. This alumi-

SPRAYING BOOTHS, flow coating units, rotating stands, and vacuum coating chamber (left to right).



FLOW COATINGS are spread more evenly over the part surfaces by rotating stands.

TRUCK being wheeled from the oven after the lacquer has been baked.

num surface is only a few molecules thick and can be wiped off easily. For protection a second lacquer coating is applied. Again the lacquer is applied by flow coating. This time, however, only a single coat is put on and then baked at 300°F for 1 hour.

At this stage the finish is completed if a simulated chromium finish is wanted.

Dying

One of the advantages of the vacuum coating process is the ability to get colors not possible in any other way. This is done by coloring the overcoat of lacquer with a dye. The result is a colored finish with the brilliant reflectivity of a plated surface. This can't be secured in any other way.

Early in the use of vacuum coating it was usual to color the overcoat before it was applied. This system had several faults.

- Different lacquers and different coating equipment were required for the overcoat application.
- In grooves and crevices color built up so that distinct color differences were apparent.
- First cost of equipment and cleaning and maintenance costs was quite high.

If a colored finish is wanted the final baking is for 30 minutes. The racks of parts are then removed from the oven and dipped into a tank of an alcohol soluble dye for one minute, then into a hot water rinse and then back into the 300°F oven for the final 30 minutes baking to completely cure the overcoat.

Unracking

From the time the parts entered the finishing department until the entire surface finish is completed they have been mounted on racks. Through the undercoating, baking, plating, overcoating, dying, and final baking are all done with the parts on the racks.

The design of racks and spiders can be an extremely important factor. Since labor charges in this operation must be cut and unskilled labor used wherever possible, any improvement in rack design can be translated into dollars saved in finishing costs.

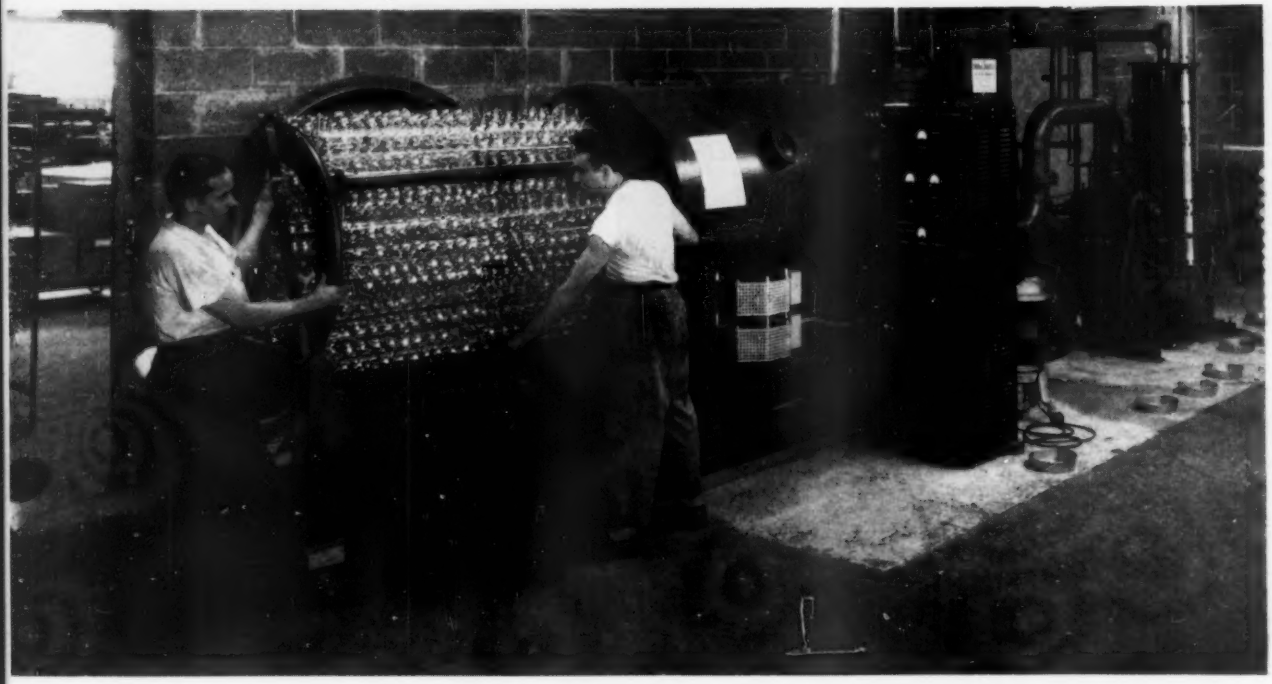
A new rack design and the use of titanium support spiders are two developments at Davis Products which have helped very materially to cut costs.

HOW ABOUT COSTS?

Over a period of several years operation there has been a cost reduction of from 25% to 80% compared with plating. The wide difference depends on whether any buffing is needed. Even with vacuum coating there are some pieces which must be hand buffed. When this is the case the saving may be as low as 25%. When no buffiing at all is needed the savings jump to 80%. There is little, if any, reduction in materials costs; almost all of it is in labor.

Equipment costs for vacuum coating and for plating are roughly comparable. The installed price for a coating system such as the one described at Davis Products is about $70,000.

continued on next page



CARRIAGE with 6 spiders being removed from the vacuum plating chamber.

WHAT'S THE FINISH LIFE?

Products of this type have a short useful life. The finish need only be good enough to last until the novelty has been purchased.

A properly applied vacuum coating has, of course, the same service life as any straight lacquer job of the same thickness and the same quality lacquer. As applied, these novelties have a good finish for at least one year. Of course, if the item is not handled much the life of the finish is indefinite. But novelties aren't supposed to last very long, that's why Davis Products makes 2,500,000 a year, and the surface finish applied will certainly be greater than the useful life.

WHEN the finishing process is completed, this novelty tray has a gleaming gold surface that looks like expensive plating.

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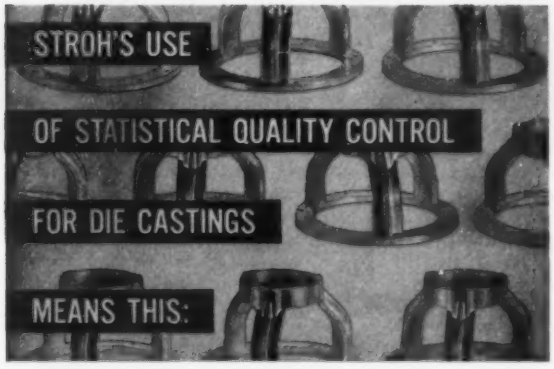

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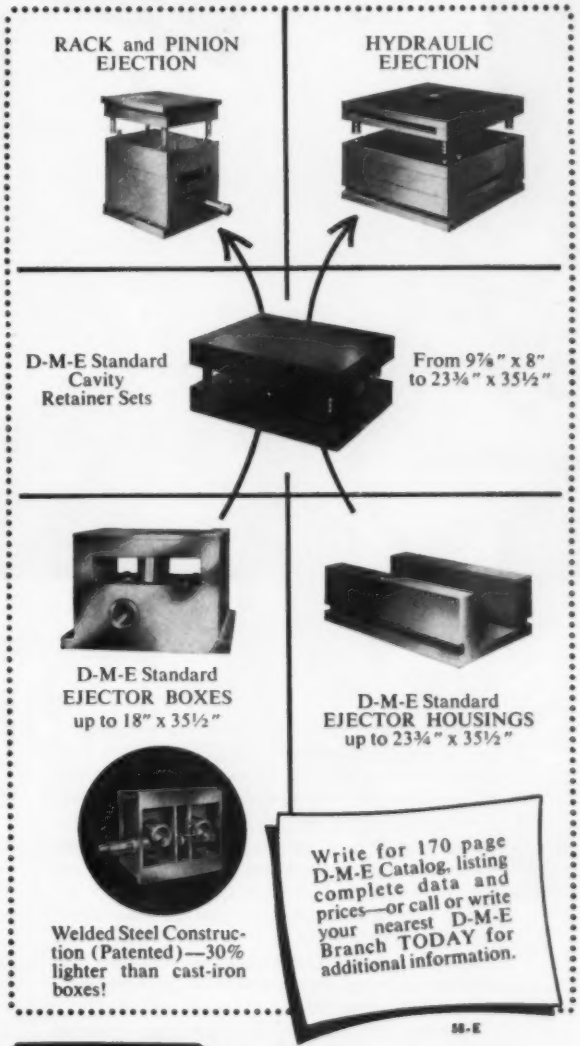
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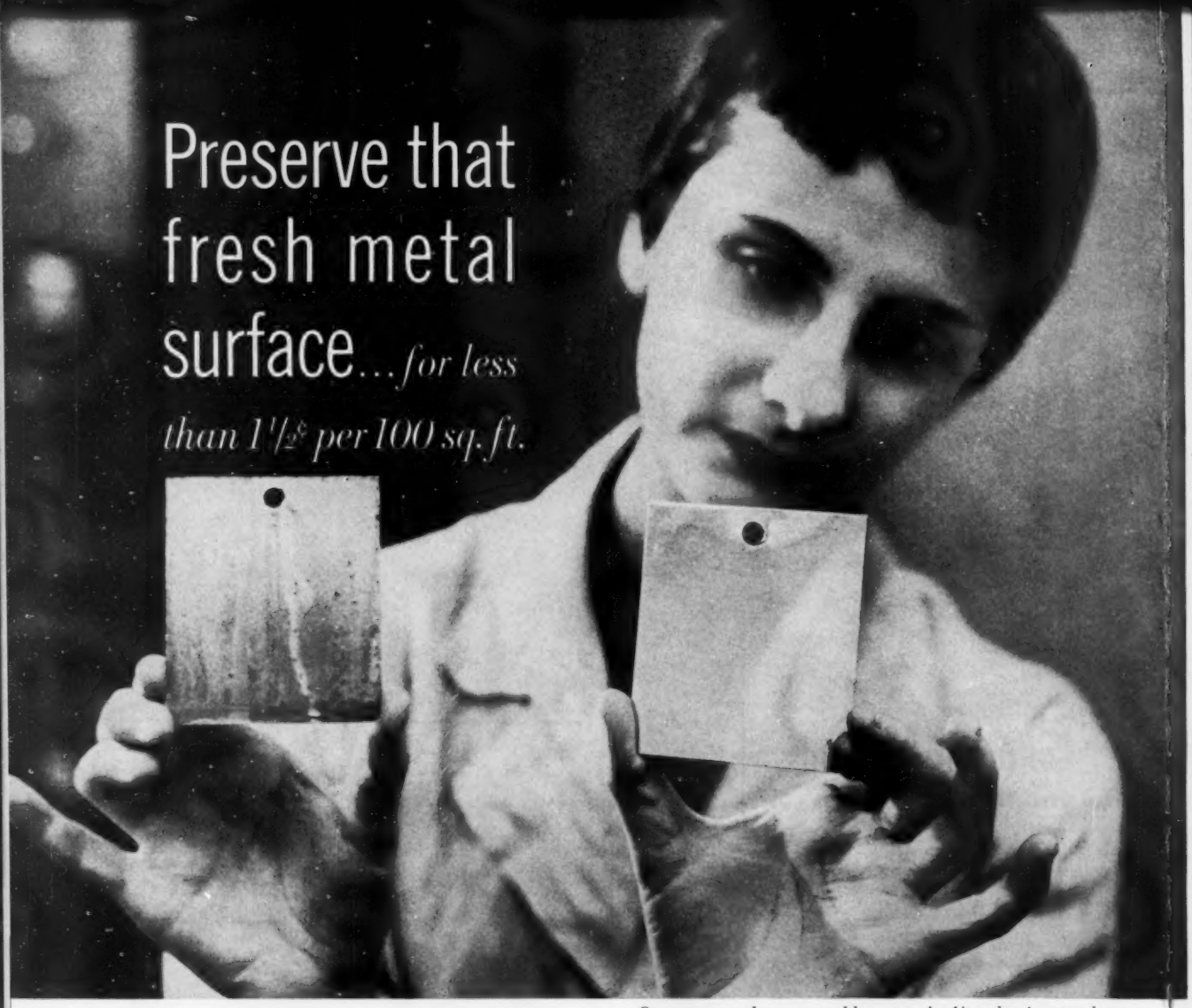

Compare treated vs untreated brass panels. After cleaning, panel on right was rinsed in Entek 45 rinse; panel on left, in standard hot water rinse. Then panels were exposed to 100% humidity at 100° F. for 100 hours. Note how Entek 45 preserves "that fresh metal surface."

From Enthonics research come Enthone Enteks, a new series of rinse water additives which coat metal surfaces with an "invisible shield" against the atmosphere. Entek 45 assures faster drying, eliminates water spots and provides lasting corrosion protection to all metals. Entek CU-55 prevents tarnishing and spotting out of copper and brass even under tropical humidity conditions.

By adding Entek 45 to your final hot water rinse, you can prevent white salt corrosion of zinc and aluminum, prevent yellowing of nickel plate, prevent tarnishing of copper and brass, prevent black spots on cadmium plate.

By treating copper and brass goods or copper or brass plated items with Entek CU-55 you can prevent tarnishing, green salt formation, spotting-out and pit corrosion under high humidity storage conditions.

Entek protection lasts for months, yet costs less than 1½¢ per 100 sq. ft. to treat your parts, less than ½¢ per gallon to make up an Entek 45 solution!

Entek 45 produces an invisible, water-repellent organic film on the metal surface which sheds water rapidly and promotes stain-free drying. This same film acts as an invisible barrier between the metal and the moisture and oxygen in the air.

Entek CU-55 reacts with copper and copper alloys to form an invisible layer which has many times the corrosion resistance of bare copper and brass. Additionally, this layer has better solderability and improves adhesion of lacquers and enamels.

Write today for complete literature on both of these products to Enthone, Inc., 442 Elm Street, New Haven, Connecticut.

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NEW PRODUCTS
(continued)

INSERT TOOL KIT

HI-SHEAR CORP.—The Insert Tool Kit easily replaces stripped-out threads with threaded inserts in plate or cast aluminum, mild steel, magnesium and cast iron. Just install the load bearing, wear resistant, self-locking threaded inserts in a drilled hole. No special counterboring or tapping is needed.

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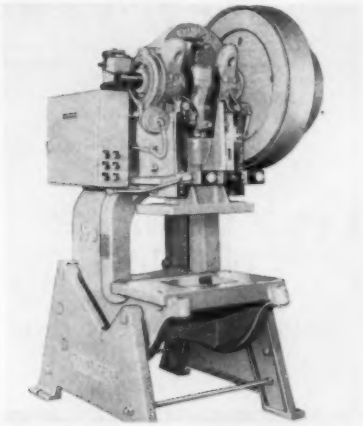
TRIMMING PRESS



JOHNSON MACHINE & PRESS CORP.—The Model 45W, 45-ton trimming press has oversize features usually available only in larger capacity presses. The bed is 33″ x 22″, ram face 22″ x 15″, opening through uprights 21″, and throat depth 12″. Clutches and drives are available.

Circle No. 241 on Reader Service Card

HIGH VACUUM GAGE

NRC EQUIPMENT CORP.—The Redhead Magnetron ultra-high vacuum, cold cathode ionization gage measures pressures down to 10^{-14} mm Hg. The sensitivity of this gage is about 50 times that of the Bayard-Alpert type. High pumping speed and cold cathode operation eliminates the need for a special means to outgas the gage element.

Circle No. 240 on Reader Service Card

LIQUID NICKEL CHLORIDE

HANSON-VAN WINKLE-MUNNING CO.—Instant liquid nickel chloride offers nickel platers several advantages over the dry material. It eliminates dissolving problems and is easier to handle and store. Just pour it into the plating bath to bring the nickel chloride content to the proper level. It needs no stirring or pre-mixing.

One gallon of liquid nickel chloride contains the equivalent of six pounds of the dry material.

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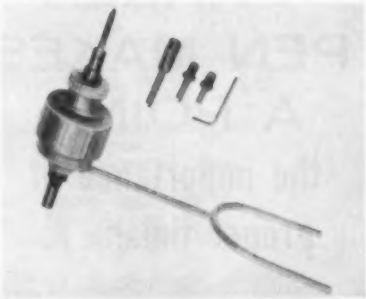
TAPPING HEAD



BABCOCK MFG. CO.—The Babco tapping head makes power tapping convenient for tool makers. It chucks in a drill press in a few seconds and costs less than $15. The head improves accuracy and saves time.

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continued on page 72

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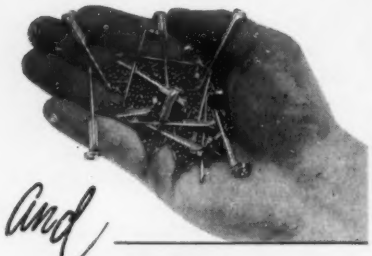
PARKER PEN MAKES A POINT:

the importance of proper finish . . .



and

how ABBOTT helps to get it

Throughout the world, a Parker Pen is quickly identified by its distinctive arrow clip. Even while clasping firmly to a coat or shirt pocket, the clip properly signals the prominent Parker name . . . in some Asian countries, it's a status symbol and a mark of the wearer's literacy!

For these and similar reasons, the clip must **always** retain a gleaming, jewel-like finish . . . a finish durable enough to withstand the roughest everyday abuse . . . a finish that has no microscopic rough edges to snag or fray pockets.

To give the clip just such a finish, Parker uses Abbott steel burnishing media in vital tumbling operations. Besides producing the lasting, polished finish, the high-quality Abbott shapes increase the clip's surface hardness by compressing and compacting the grain structure of the metal.

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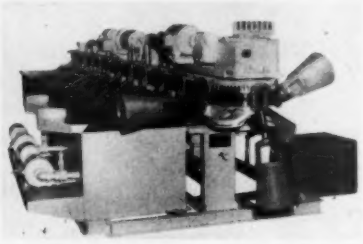
NEW PRODUCTS *(continued)*

BARREL FINISHING MACHINE



FREDERIC B. STEVENS INC.—A compact, automatic barrel finishing machine for the precision plating and processing of small parts offers mechanical flexibility and simplicity of control. It can be quickly adapted to meet most processing requirements. The elimination or addition of processing steps is made by simple mechanical adjustment.

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PREVENTS SMUT

ENTHONE, INC.—Ebonol Additive "S" for steel blackening baths prevents red smut from forming on blackened work. The additive is a liquid which can be added to any hot, alkaline blackening solution. It produces a deeper black color, reduces blackening time, and improves results with steel alloys.

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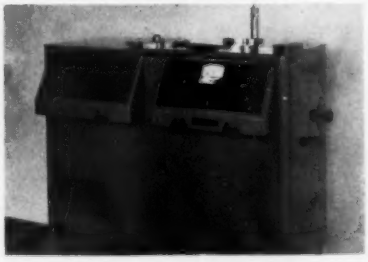
VACUUM UNITS



HIGH VACUUM EQUIPMENT CORP.—A new line of self-contained, portable high-speed, vacuum pumping carts provides pressures of 5×10^{-6} mm Hg without a cold trap, and 5×10^{-7} mm Hg with a liquid nitrogen trap. The carts can be equipped with pumping port adapters for matching a wide range of vacuum furnaces, evaporators, environmental chambers, and other units.

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THREAD PITCH GAGE

SCHERR-TUMICO—You can determine the size of a screw thread without referring to a table or making calculations by using the O-Vee gage and a standard micrometer. The gage provides the accuracy of the Wire Method of pitch measurement, but is much simpler to use.

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continued on page 117

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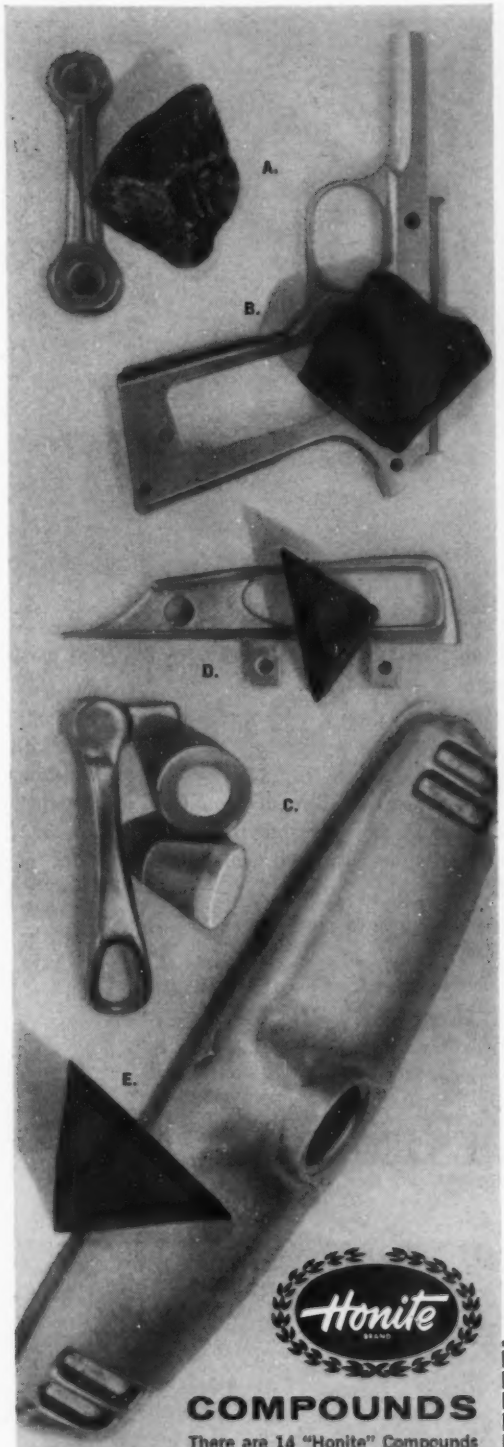

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A. "HONITE" – A tough, low cost, long-wearing natural stone containing a micro-crystalline abrasive. Excellent for minor stock removal and burnishing in long run cutting cycles. Available in nine sizes. *The steel alloy outboard motor crankshaft pictured was descaled and smoothed with "Honite" and "Honite" Compound #280 followed by #373.*

B. "SUPER-HONITE" – A manufactured chip consisting of a fine-grained, fused aluminum oxide bonded abrasive. Fast cutting and long-wearing – provides a fine, smooth finish on all types of metal. Available in nine sizes. *The hard steel automatic pistol frame was deburred with "Super-Honite" and "Honite" Compound #240; polished with "Super-Honite"and "Honite" Compound #120.*

C. "HONITE" BRAND CERAMICONES – A long-wearing porcelain-type, ceramic medium manufactured in precise cone-shaped dimensions. Ideal for deburring, honing, coloring, or burnishing where lodging is a problem. *The yellow brass handle pictured was deflashed and smoothed with "Ceramicones" and "Honite" Compound #300.*

D. "HONITE" BRAND Z-N TUMBLING SHAPE – A light-weight medium featuring a new bonding material and extremely fine mesh abrasive. Designed to produce fine surfaces on zinc alloys and other metals prior to plating. Often eliminates the need for costly buffing. *The zinc die-cast locker handle pictured was honed and burnished for plating with "Z-N" 3T Tumbling Shape and a newly developed "Honite": Compound.*

E. "HONITE" BRAND C-R TUMBLING SHAPE – A light-weight, fast-cutting medium for use on all metals. Triangular shaped and extremely fracture resistant to prevent lodging. Light weight produces fine, micro-inch finishes without impingement. Available in three sizes. *The aluminum alloy vacuum cleaner head was deburred and prepared for painting with "C-R" 2T Tumbling Shape and "Honite" Compound #240.*

HERE'S HOW you can get the latest information on barrel finishing. VISIT THE "HONITE" BOOTH AT THE NATIONAL METAL EXPOSITION IN PHILADELPHIA OCTOBER 17-21.

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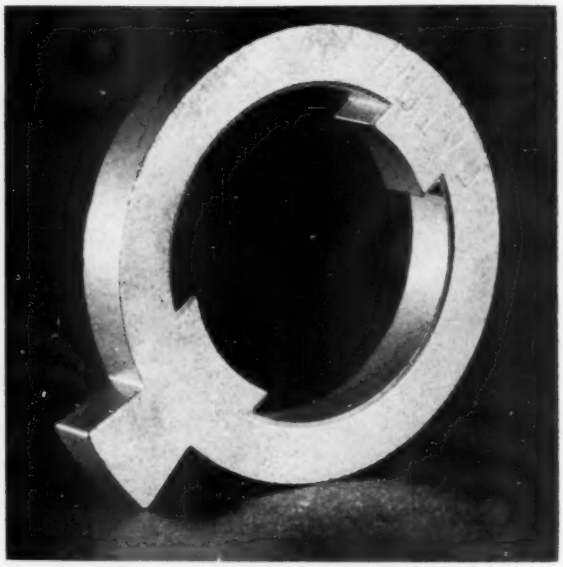
DESIGN FOR THE PMM PROCESSES

COPPER-STEEL DOG WITHSTANDS IMPACT



THE POWDERED METAL washer type unit illustrated acts as a dog on a multi-speed clutch of a washer-dryer combination's main drive shaft. Torque load is substantial. Impact loads are continuous, as anyone can verify who has listened to the bumping and whirring of an automatic washer-dryer in operation. The clutch engaging causes a terrific load to bear on the dog, which must have the strength of cold roll steel.

Eaton Manufacturing Co. engineers turned to copper infiltered steel. The alloy is 1% carbon, 74% iron and 25% copper. If necessary, the alloy used can be hardened to a file hard condition for special wear applications.

Substantial cost reductions are realized by manufacturing the dog as a sintering. No cutting or smooth finishing operations are required. Amount of handling in the shop is reduced. Raw material costs are approximately equal that of steel but production time is cut.

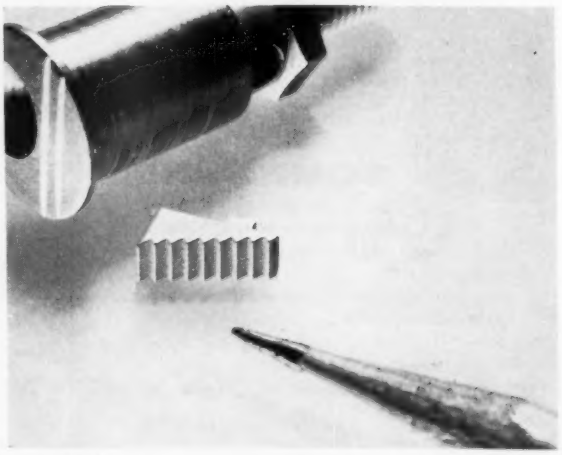
The sintered dog has worn well through long testing periods.

SURE GRIP JAW IS INVESTMENT CAST

A NATURAL FOR INVESTMENT CASTING is the clamp jaw used to lock telephone wire on a portable switchboard. In operation the terminal plug is depressed to spread a pair of these jaws. When released, a spring-loaded mechanism closes the jaws, clamping the wire securely.

The part is ideal for high-volume precision production. Nearly three million have already been produced at a selling price of less than eight cents each. Mass produced by investment casting cut original fabricating costs considerably. Some dimensions are held within a tolerance of .001", all others are cast to .003".

Being investment cast in a cobalt-chrome alloy, the jaws have good wear resistance. Also, the fluidity of the alloy enables the producer, Casting Engineers, Inc. to hold an average radius of .003" on the teeth for effective clamping action.



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IRILAC™
CLEAR PROTECTIVE COATINGS

Now, here's a fast, easy, economical way to almost double the protection against corrosion on your product. Simply follow up the IRIDITE process with a fast, easy application of IRILAC . . . and you've given your product extra protection for longer resistance to corrosive conditions, longer shelf or storage life protection from handling, and increased beauty for more attractive appearance and faster sales.

ON ALUMINUM

An IRIDITE-IRILAC finish will provide longer life for storm doors, windows, outdoor furniture, auto parts and accessories, tubing or wire goods. And, you have a choice of color finishes such as natural aluminum and golden yellow. Other colors may be obtained by an additional dye operation.

ON MAGNESIUM

IRILAC over an IRIDITE No. 15 finish increases corrosion protection, and provides resistance to finger printing and abrasion on all types of products, with color appearance ranging from light to dark brown.

ON ZINC

IRIDITE plus IRILAC gives your product longer life and brighter appearance. Color choices range from clear IRIDITE to olive drab, plus colored dye finishes.

IRIDITE is the tradename for a specialized line of chromate conversion coatings that can be applied to any non-ferrous metal by brush, dip or spray methods—at room temperatures—manually or with automatic equipment. Upon application, a thin film forms which becomes an integral part of the metal itself, and thus cannot chip, flake or peel. No special equipment, exhaust systems or specially trained personnel are required.

IRILAC is the tradename for a line of clear protective coatings for all metals. As safe and easy to handle as water, they may be applied by brush, dip or spray methods. No exhaust or special fire protection equipment required. Adds protection and abrasion resistance to any base metal, plated part or parts treated with electrolytic or chemical post treatments, without chemical change.

For complete technical information on IRIDITE Chromate Conversion Coatings or IRILAC Clear Protective Coatings, write for FREE TECHNICAL MANUAL. Or, see the Allied Field Engineer in your area. He's listed under "Plating Supplies" in the yellow pages.

Allied Research Products, Inc. 4004-06 EAST MONUMENT STREET • BALTIMORE 5, MARYLAND
BRANCH PLANT: 400 MIDLAND AVENUE • DETROIT 3, MICHIGAN
West Coast Licensee for Process Chemicals: L. H. Butcher Co. • European Agent: Stora Gronberger, Storgatan 10, Stockholm, Sweden

Chemical and Electro chemical Processes, Anodes, Rectifiers, Equipment and Supplies for Metal Finishing

IRIDITE® Chromates | IRILAC® Coatings | ISOBRITE® Brighteners | ARP® Supplies | WAGNER Equipment

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WHY MORE PEOPLE are coming to us for EXTRUSIONS FABRICATIONS and FINISHING

EXTRUDED ALUMINUM FRAME for a door on a refrigerated case. Lighter weight, stronger, better looking than the older design. Another big advantage, about one-half the cost of the old frame.

AN EXTRUDED CABINET—DOOR FRAME

- **Separate Door Handle Eliminated**
- **Spot-welded Joints Eliminated**
- **Ready-made Grooves for Rubber Bumpers**
- **Wheel Brackets Eliminated**

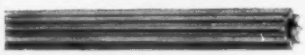
We have complete and modern facilities for fabricating and anodizing. We are a skilled producer of precision aluminum mouldings.

Chances are we can help you, too. Why not write us today.

Before you buy another extrusion... CHECK THIS LIST

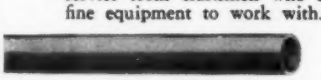
☑ QUALITY

We'll give you a clear surface free of "pick-up" . . . close tolerances . . . expert handling . . . packaging to your specifications.



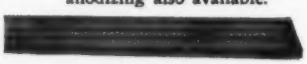
☑ DIE SERVICE

We'll give you fast, skilled die service from craftsmen who have fine equipment to work with.



☑ ANODIZING

We'll give you high quality anodizing using 26' tanks to meet your maximum requirements. Color anodizing also available.



☑ DELIVERY

We'll give you high quality anodizing using 26' tanks to meet your maximum requirements. Color anodizing also available on volume orders.

☑ ABILITY TO MEET YOUR SPECIFICATIONS

Tell us what you want. We have the people and the facilities to do it.

ALUMINUM EXTRUDERS • ANODIZERS • ARTRIM MOULDINGS

SUPERIOR INDUSTRIES INC.

3788 Oakwood Ave. • Youngstown, Ohio

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Precision Metal Molding

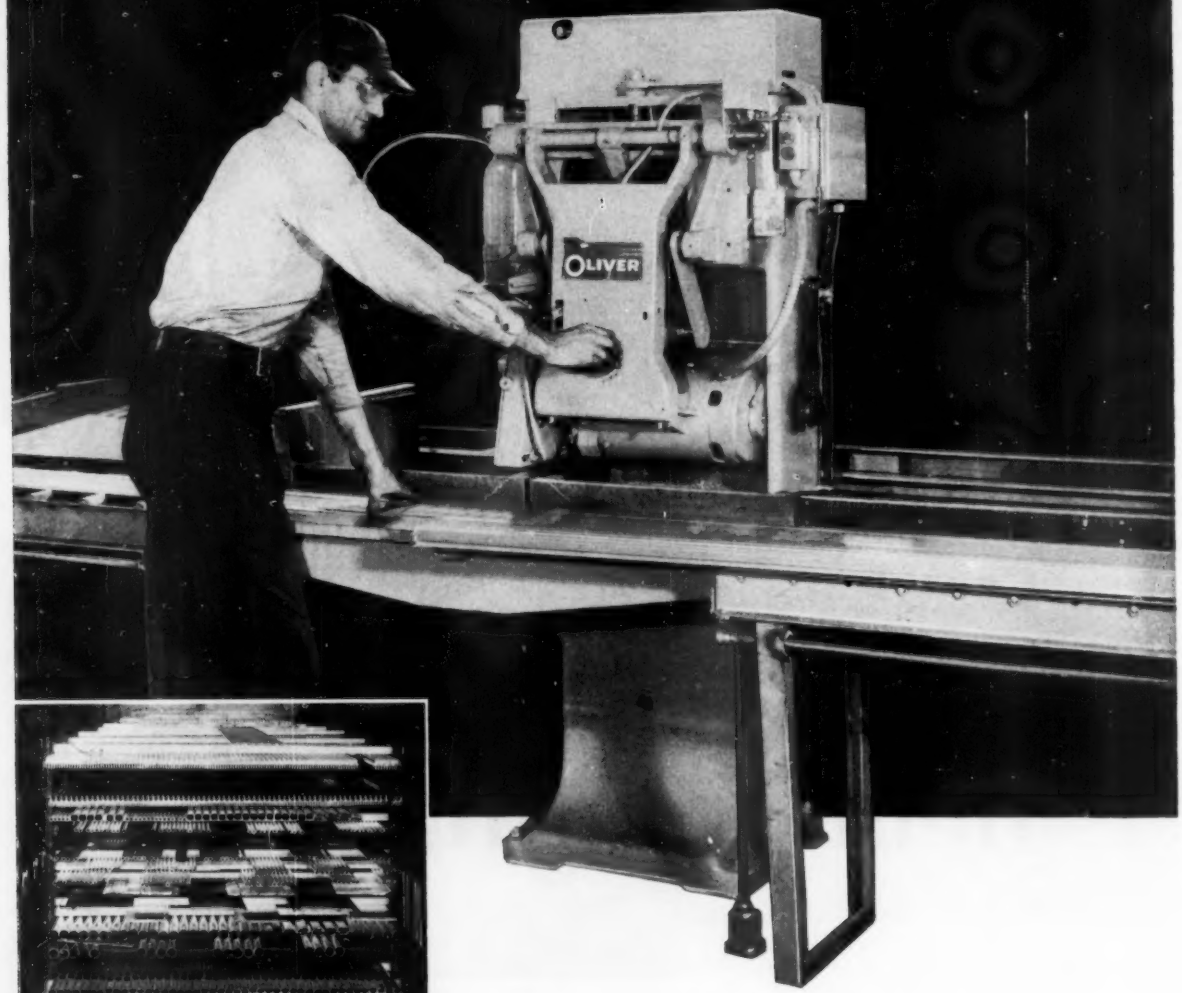
SECTION 1/PRODUCT LISTING — EXTRUSIONS ..... PAGE 79

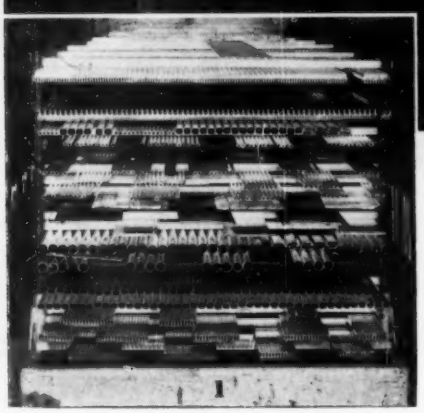
SECTION 2/PRODUCT LISTING — EQUIPMENT & SUPPLIES ..... PAGE 89

SECTION 3/PRODUCT LISTING — PROPRIETARY PRODUCTS ..... PAGE 94

SECTION 4/BUYER'S GUIDE ..... PAGE 99

Aluminum extrusion plant chooses "OLIVER" 94-DHX as "finest equipment money can buy"





Mideast Aluminum Corp. officials state that Oliver Saw proves its efficiency, dependability, versatility and speed under actual production conditions.

Ray B. Sowers and Robt. J. Gilfillan, President and Vice President, respectively, of Mideast Aluminum Corp., Dayton, N. J., chose Oliver's 94-DHX Cut Off Saw for their own semi-automated modern aluminum extrusion plant "in keeping with their policy of buying the finest equipment that money can buy."

The Oliver Saw proved itself, says Mr. Gilfillan, "when we ran it constantly for 24 hours a day, 6 days a week for months on end with absolutely no maintenance down time while cutting hard alloys (2014S) where squareness of cut was ¼ commercial tolerance."

"In our operation we specialize in high production of small extrusions; consequently our equipment must be fast, rugged, versatile and, above all, maintenance-free. Your saw more than meets these requirements," states Mr. Sowers.

Send for folder giving full details of the Oliver 94-DHX.

OLIVER MACHINERY COMPANY

GRAND RAPIDS 2, MICHIGAN

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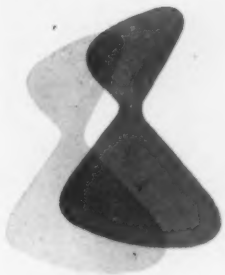

EXTRUSIONS

ALUMINUM

Adams & Westlake Co., The (F-M-A)

Aerolite Extrusion Co. (F-A)

Air Master Corp. (M-A)

All-State Welding Alloys Co., Inc. (F)

Almetco, Inc.

Alsco, Inc. (F-M-A)

Aluminum Air Seal Mfg. Co. (F)

Aluminum Co. of America (F-M)

Aluminum Extruders, Ltd. (F-M-A)

Aluminum Extrusion Co. (F)

Aluminum Extrusions, Inc. (F-M-A)

Aluminum Mill Supply Corp.

American-International Aluminum Corp. (Miami Plant) (F-M-A)

American-International Alum. Corp. (San Jose Plant) (F)

Anaconda Aluminum Co.

V. E. Anderson Mfg. Co., Inc. (M-A)

Arvin Industries, Inc. (F-A)

Aywon Wire & Metal Corp. (F-M-A)

B & T Metals Co. (F)

Badger Aluminum Extrusions (F-M-A)

Balcrank, Inc. (F-M-A)

Barberton Metal Products Co., Inc. (F)

Bauer Aluminum Co.

Bayless Products, Inc.

Benson Aluminum Co., Inc. (M)

Bohn Aluminum & Brass Corp. (F-M-A)

William L. Bonnell, Co. Inc., The (F-M)

Brazeway, Inc. (F-M-A)

Bridgeport Brass Co. (F-M-A)

Bristol Aluminum Co. (M-A)

Calex Corp. (A)

Canadian Mouldings Ltd. (F-M-A)

F—Company does finishing
M—Company does machining
A—Company does assembly

Capitol Products Corp. (M-A)

Cardinal Extrusions Co. (F)

Ceco Steel Products Corp. (F-M-A)

Channel Master Corp. (A)

Colonial Alloys Co. (F-M-A)

Colotrym Co., The (F)

Commonwealth Extrusion Corp. (F-A)

Corson Industries (F)

Croft Metal Products, Inc. (M-A)

Curtiss-Wright Corp. (F-M-A)

Detroit Gasket & Mfg. Co. (F-M-A)

Dixie Aluminum Corp. (F-M-A)

Dow Metal Products Co., The
Div. of The Dow Chemical Co. (F-A)

Extruded Alloys, Inc. (F-M-A)

Extruded Aluminum Co., Inc. (F-M-A)

Extrusions, Inc. (F-A)

Fay Machine Prod., Inc. (F-M-A)

Fentron Industries (F-A)

Ferguson Extrusions, Inc. (M-A)

C. M. Flynn Mfg. Co. (F-M-A)

Flynn Extrusion Corp. (F-M-A)

Michael Flynn Mfg. Co. (F-A)

Fullview Corp. (F-M-A)

General Extrusions, Inc. (F-M-A)

Greater Louisville Industries, Inc.

Harvey Aluminum (A)

Heinz Mfg. Co.
Div. of Kelsey Hayes (F-M-A)

Hercules Aluminum Corp. (M-A)

Hillman Mfg.
Angelus Aluminum Div. (F-M-A)

Himmel Bros. Co., The (F-M-A)

Jarl Extrusions, Inc. (F)

Jasco Aluminum Products
Div. of Unexcelled Chem. Sales, Inc. (F-M-A)

Jerex Corp. (M)

Kaiser Aluminum & Chem. Corp.

Kawneer Co. (F-A)

Kinkead Industries, Inc. (F-A)

Kroh-Wagner (F-A)

Light Metals Corp. (F-M-A)

Linderme Extrusions, Inc.

Loxcreen Co., Inc., The (F-M-A)

Magnode Prod., Inc.

Mainline Extrusions, Inc. (M)

Mala Extrusions Inc. (F)

Marsh Wall Prod., Inc. (F)

May, Inc. (F)

Metal Masters, Inc. (F-M-A)

Metal Trims, Inc. (F-M-A)

Miami Extruders, Inc.

Mideast Aluminum Corp.

Midwest Aluminum Corp. (F)

Miller Industries, Inc. (F-M-A)

Moloney Co., The (F-M-A)

National Aluminum Co. (F-M-A)

National Extrusion & Mfg. Co. (F-M-A)

New Jersey Alum. Extr. Co., Inc. (F-A)

New York Metal Moulding Co., Inc. (F-M)

North American Extrusions Corp. (F-M-A)

Northeast Aluminum, Inc. (F-M-A)

Nuclear Metals, Inc. (F-M-A)

**Olin Mathieson Chem. Corp.
Metals Div.**

Pacific Extrusions, Inc. (F)

Pax Metal Corp.

Penn Extrusion Corp.

Pfister Aluminum Corp. (A)

F. A. Pilgrim Extrusion Co., Inc. (F-M-A)

Pittsburgh Aluminum Alloys (F-M-A)

Precision Extrusions Co., Inc.

Purpose Extruded Aluminum, Inc. (M-A)

Quality Aluminum Prods. Co.

Revere Copper & Brass, Inc.

Reynolds Metals Co. (M-A)

Rogers Industries, Inc. (M-A)

continued on page 82

Celanese chemicals make heat

From Celanese research come the chemical answers to industry's critical problems of high-temperature application. By eliminating many of the basic hazards of heat and fire, Celanese is contributing to the safety of industry.

Synthetic chemicals by Celanese help protect against extreme loss by fire or explosion. They include Cellulubes, fire resistant lubricants and hydraulic fluids . . . Cellutherms, for jet engine-temperature applications . . . fire resistant plasticizers . . . fire retardant additives for paints and varnishes. Celanese research has contributed substantially toward conquering the problems of fire and heat in industry. A pioneer in fire-resistant fluids and chemicals, Celanese has years of experience to put to work to make your plant or application safer, more efficient. For more details, please write to us, outlining your specific interest. Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 589-J 180 Madison Avenue, New York 16, N. Y.

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Celanese
CHEMICALS

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Export Sales: Amcel Co., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16

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Royal Aluminum, Inc. (F-M)

Royce Aluminum Corp. (F-M)

Saramar Aluminum (F-A)

F. E. Schumacher Co. (M-A)

Allan Scott Aluminum Corp. (F-A)

Shower Door Co. of America (F-M-A)

Southern Extrusions Corp. (F)

Southern Extrusions, Inc. (F)

Standard Magnesium Corp. (M-A)

Stanley Building Specialties
Div. of the Stanley Works (F-M-A)

Steel Industries, Inc. (F-M-A)

Superior Industries, Inc. (F-M-A)

Titus Metals Corp. (A)

Torrance Brass Foundry, Inc. (M)

Townsend Co. (F)

Trim Alloys, Inc. (F-M-A)

U. S. Extrusions Corp. (F)

Valley Metal Prods. Co. (F-M-A)

Vosler Aluminum Corp. (F)

Warner Mfg. Corp. (M-A)

Weather-Tite Div.
Aluminum Extrusions Corp. (F-M-A)

Wells Aluminum Corp. (M-A)

R. D. Werner Co., Inc. (F-M-A)

White Metal Rolling & Stamping Corp.
(F-M-A)

David L. Wilkoff Co., Inc. (M-A)

Wisco Inc. (M-A)

Wolverine Tube
Div. of Calumet & Hecla, Inc.

Youngstown Mfg., Inc. (F-M-A)

BERYLLIUM

Ampco Metal, Inc. (M-A)

Bridgeport Brass Co. (F-M-A)

Extrusions, Inc.
Caldwell, N.J. (F-A)

Janney Cylinder Co. (F-M-A)

Nuclear Metals, Inc. (F-M-A)

Torrance Brass Foundry, Inc. (M)

BRASS

American Brass Co., The (F)

Anaconda American Brass Co.

Avins Industrial Prod. Corp. (M)

Bohn Aluminum & Brass Co. (F-M-A)

Bristol Brass Corp., The

Chase Brass & Copper Co., Inc.

Chicago Extruded Metals Co.

Detroit Gasket & Mfg. Co. (F-M-A)

Extrusions, Inc.
Caldwell, N.J. (F-A)

H. M. Harper Co.

Heinz Mfg. Co. (F-M-A)

Janney Cylinder Co. (F-M-A)

Lewin-Mathes Co.
Div. of Cerro De Pasco Corp.

New York Metal Moulding Co., Inc. (F-M)

Nuclear Metals, Inc. (F-M-A)

Phelps Dodge Copper Prod. Corp. (F-M)

Revere Copper & Brass Inc.

Scovill Mfg. Co. (F-M-A)

Titan Metal Mfg. Co.
Div. of Cerro de Pasco Corp.

Torrance Brass Foundry, Inc. (M)

Townsend Co. (F)

David L. Wilkoff Co., Inc. (M-A)

BRONZE

American Brass Co., The (F)

Ampco Metal, Inc. (M-A)

Anaconda American Brass Co.

Bohn Aluminum & Brass Co. (F-M-A)

Bristol Brass Corp., The

Chase Brass & Copper Co., Inc.

Chicago Extruded Metals Co.

Detroit Gasket & Mfg. Co. (F-M-A)

Extrusions, Inc.
Caldwell, N.J. (F-A)

H. M. Harper Co.

Janney Cylinder Co. (F-M-A)

Nuclear Metals, Inc. (F-M-A)

Phelps Dodge Copper Prod. Corp. (F-M)

Revere Copper & Brass Inc.

Scovill Mfg. Co. (F-M-A)

Titan Metal Mfg. Co.
Div. of Cerro de Pasco Corp.

Torrance Brass Foundry, Inc. (M)

David L. Wilkoff Co., Inc. (M-A)

COPPER

American Brass Co., The (F)

Anaconda American Brass Co.

Bridgeport Brass Co. (F-M-A)

Chase Brass & Copper Co., Inc.

Chicago Extruded Metals Co.

Extrusions, Inc.
Caldwell, N.J. (F-A)

Halstead Metal Prod., Inc. (A)

Heinz Mfg. Co. (F-M-A)

Janney Cylinder Co. (F-M-A)

Lewin-Mathes Co.
Div. of Cerro De Pasco Corp.

Nuclear Metals, Inc. (F-M-A)

Phelps Dodge Copper Prod. Corp. (F-M)

Revere Copper & Brass Inc.

Scovill Mfg. Co. (F-M-A)

Steel Industries, Inc. (F-M-A)

Torrance Brass Foundry, Inc. (M)

Townsend Co. (F)

Wolverine Tube
Div. of Calumet & Hecla, Inc.

LEAD

M. W. Dunton Co., The

Extrusions, Inc.
Caldwell, N.J. (F-A)

Nuclear Metals, Inc. (F-M-A)

Vulcan Lead Prod. Co. (M-A)

White Metal Rolling & Stamping Corp.
(F-M-A)

MAGNESIUM

Dow Metal Products Co., The
Div. of The Dow Chemical Co. (F-A)

Extrusions, Inc.
Caldwell, N.J. (F-A)

Magnode Prod., Inc.

Nuclear Metals, Inc. (F-M-A)

Standard Magnesium Corp. (M-A)

White Metal Rolling & Stamping Corp.
(F-M-A)

STEEL, Low Alloy

Allegheny Ludlum Steel Corp. (F-A)

Babcock & Wilcox Co.

Curtiss-Wright Corp. (F-M-A)

Extrusions, Inc.
Caldwell, N.J. (F-A)

H. M. Harper Co.

Heinz Mfg. Co. (F-M-A)

Nuclear Metals, Inc. (F-M-A)

Steel Industries, Inc. (F-M-A)

Torrance Brass Foundry, Inc. (M)

Townsend Co. (F)

David L. Wilkoff Co., Inc. (M-A)

STEEL, Stainless & High Alloy

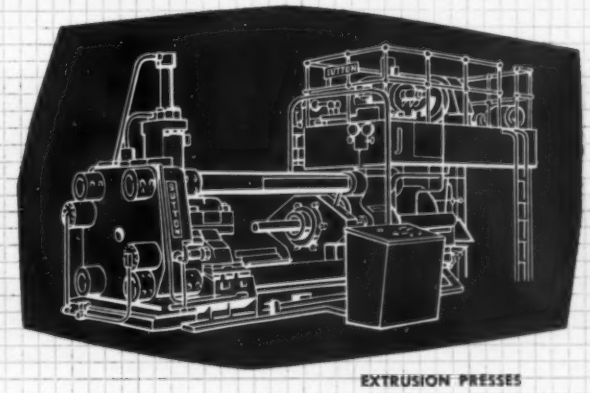
Allegheny Ludlum Steel Corp. (F-A)

Aluminum Mill Supply Corp.

Babcock & Wilcox Co.

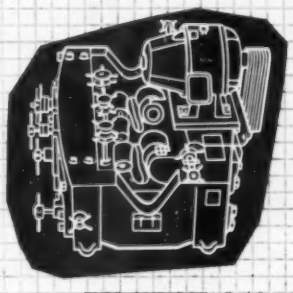
continued on page 84

F—Company does finishing
M—Company does machining
A—Company does assembly

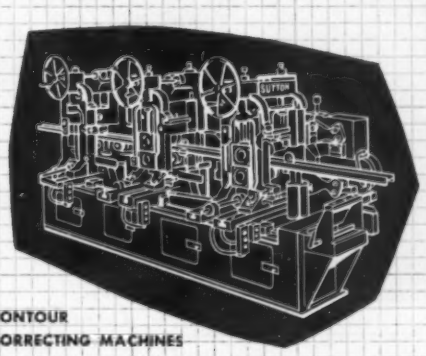


EXTRUSION PRESSES

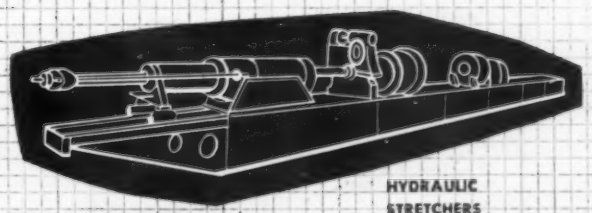
What is right for modern extruders?



TUBE AND BAR
STRAIGHTENERS



CONTOUR
CORRECTING MACHINES



HYDRAULIC
STRETCHERS

SUTTON extrusion presses, finishing machines and complete extrusion plants are designed and engineered for tomorrow's needs. Much otherwise good machinery available today is based on designs of earlier years, when high-speed production was not so insistent a problem. Trends in modern metal extruding point to the needs for faster cycles, increased work-load and more automatic controls with reduced maintenance. Sutton-built extrusion presses and finishing machines are engineered with a fresh viewpoint, looking to tomorrow, to be right for modern extruders.

Ask for Extrusion Bulletin No. 60

SUTTON *Engineering Company*

MANUFACTURERS FOR FERROUS AND NON-FERROUS METAL INDUSTRIES

Extrusion Presses • Straighteners • Hydraulic Stretchers • Contour Correcting Machines
Dotwisters • Sheet Levellers • Straightening Presses • Heavy-Duty Universal Joints • Rolls

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4 more cost-cutting examples of

P-E ALUMINUM *Extrusioneering*

Here are more examples of P-E Aluminum Extrusioneering. All angles, flutes and varying thicknesses required for each piece are produced in a single operation without machining. Each design offers inherent advantages of greater strength in less weight and the plus benefits of a durable, non-corrosive finish. As indicated, the experience of P-E engineers provides invaluable aid in the functional design of extruded shapes which effect substantial savings in manufacturing costs.

ADVANTAGES OF P-E EXTRUSION MILL SERVICE

5,000 SHAPES
Mill run shapes available without die charge in a wide range of rod, bar, and tubing sizes, and numerous shapes.

NON-COMPETITIVE
We produce extrusions only, do not fabricate or manufacture any other product. You get experienced, confidential help in creating any special shape to suit your needs.

LOW DIE COST
Experienced engineering, design, and die making services save you time and money, make small or experimental runs practical.

VERSATILE EQUIPMENT
Small, medium, and large presses permit economical production. Complete integrated facilities from billet casting to finished extrusion.

SIMPLE, COMPLEX—LARGE OR SMALL

You'll find P-E is also well equipped to produce almost any type or size extrusion to serve your needs. For example, there are over 5000 standard cataloged shapes available without a die service charge, or, if necessary, special shapes can be designed and experimental runs provided at low cost to suit your specific needs.

WRITE FOR FREE CASE STUDIES — For more facts about P-E's Extrusioneering service write for case study bulletins illustrating actual solutions to design problems.

PRECISION EXTRUSIONS, INC.
725 E. GREEN AVENUE • BENSENVILLE, ILLINOIS
Phone: POrter 6-0340 • (Chicago) NAtional 5-4600

Chicagoland's Oldest, Most Experienced Aluminum Extruder

SALES OFFICES	INDIANAPOLIS	MILWAUKEE	GRAND RAPIDS	MINNEAPOLIS	DETROIT
	CLifford 1-8525	BRoadway 2-1307	GLendale 6-1382	WAlnut 2-6888	TUxedo 1-5400

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Curtiss-Wright Corp. (F-M-A)
Extrusions, Inc. Caldwell, N.J. (F-A)
H. M. Harper Co.
Harvey Aluminum
Heinz Mfg. Co. (F-M-A)
Janney Cylinder Co. (F-M-A)
Nuclear Metals, Inc. (F-M-A)
Steel Industries, Inc. (F-M-A)
Torrance Brass Foundry, Inc. (M,

TITANIUM

Bridgeport Brass Co. (F-M-A)
Chase Brass & Copper Co., Inc.
Curtiss-Wright Corp. (F-M-A)
Extrusions, Inc. Caldwell, N.J. (F-A)
H. M. Harper Co.
Harvey Aluminum (A)
Janney Cylinder Co. (F-M-A)
Nuclear Metals, Inc. (F-M-A)
Titanium Metals Corp. of America
Torrance Brass Foundry, Inc. (M)
Wolverine Tube Div. of Calumet & Hecla, Inc.

ZINC

Janney Cylinder Co. (F-M-A)
Nuclear Metals, Inc. (F-M-A)

ZIRCONIUM

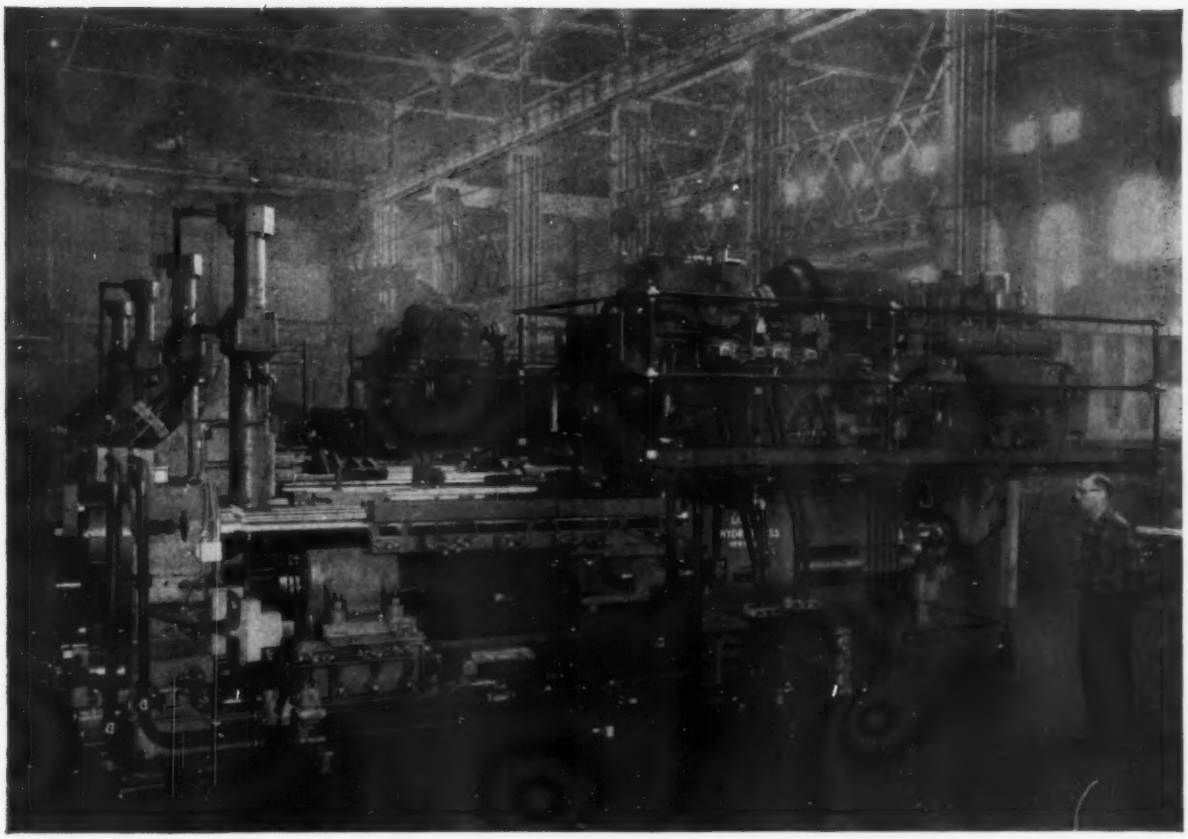
Allegheny Ludlum Steel Corp. (F-A)
Bridgeport Brass Co. (F-M-A)
Chase Brass & Copper Co., Inc.
Extrusions, Inc. Caldwell, N.J. (F-A)
Harvey Aluminum (A)
Janney Cylinder Co. (F-M-A)
Nuclear Metals, Inc. (F-M-A)
Torrance Brass Foundry, Inc. (M)
Wolverine Tube Div. of Calumet & Hecla, Inc.

MISCELLANEOUS

Chicago Extruded Metals Co. (Nickel Silver)
M. W. Dunton Co., The (Solder, tin)

continued on page 86

F—Company does finishing
M—Company does machining
A—Company does assembly



Battery of Loewy 1500-ton extrusion presses, piped and wired on the erection floor before shipment to customers' plants

New workhorse for prime and secondary window industry...

LOEWY 1500-TON EXTRUSION PRESS

Here is an extruder that specifically meets the requirements of suppliers to the architectural and building trades.

Recent installations of B-L-H's new oil-hydraulic self-contained Loewy 1500-tonner—the only press with all alignment adjusting points located externally—show:

- **Enhanced flexibility in range of extruded product**
- **Greatly increased billet weight per push**
- **Extrusion conversion costs reduced more than ever**
- **Highly accelerated extrusion speed for the fast-running heavy sections**

Our presses come completely piped, wired, and, if desired, equipped with furnace and auxiliaries.

Write Dept. T-10 for detailed information on this new Loewy model and discuss with our engineers—without obligation, of course—the savings you can realize with it. Should you be considering the construction of a new extrusion press installation, you may want to take advantage of our free consulting service, which covers everything from plant planning to full operation.

BALDWIN · LIMA · HAMILTON

Industrial Equipment Division • Philadelphia 42, Pa.

Circle No. 14 on Reader Service Card

Handy & Harman
(Silver and Silver alloys)

Janney Cylinder Co. (F-M-A)
(Nickel Alloys)

New York Solder Co., Inc.
(Solder)

Revere Copper & Brass Inc.
(Nickel silver)

Ronson Metals Corp. (F)
(Rare Earth Metal & Alloy Products)

Torrance Brass Foundry, Inc. (M)
(Columbium, Hafnium, Yttrium, Molybdenum, Tantalum, Uranium)

White Metal Rolling & Stamping Corp.
(F-M-A) (Tin-Cadmium)

IMPACT EXTRUDERS

ALUMINUM

American Extrusion Corp.

Braun Engr. Co.

Cliff Mfg. Co. (M)

Eaton Mfg. Co.
Valve Div. (F-M)

Impact Extrusions, Inc.

Impact Extrusion Prods., Inc.

Matthews Corp. (F-M-A)

National Impacted Metal Corp.

BERYLLIUM

Janney Cylinder Co. (F-M-A)

BRASS

Eaton Mfg. Co.
Valve Div. (F-M)

Impact Extrusions, Inc.

Janney Cylinder Co. (F-M-A)

Matthews Corp. (F-M-A)

National Impacted Metal Corp.

BRONZE

Eaton Mfg. Co.
Valve Div. (F-M)

Janney Cylinder Co. (F-M-A)

Matthews Corp. (F-M-A)

COPPER

Impact Extrusions, Inc.

Janney Cylinder Co. (F-M-A)

Matthews Corp. (F-M-A)

National Impacted Metal Corp.

MAGNESIUM

National Impacted Metal Corp.

STEEL, Low alloy

Braun Engr. Co.

Eaton Mfg. Co.
Valve Div. (F-M)

Matthews Corp. (F-M-A)

STEEL, High alloy & Stainless

Braun Engr. Co.

Eaton Mfg. Co.
Valve Div. (F-M)

Janney Cylinder Co. (F-M-A)

Matthews Corp. (F-M-A)

TITANIUM

Eaton Mfg. Co.
Valve Div. (F-M)

Janney Cylinder Co. (F-M-A)

ZINC

Impact Extrusion Prods., Inc.

Janney Cylinder Co. (F-M-A)

Matthews Corp. (F-M-A)

National Impacted Metal Corp.

ZIRCONIUM

Janney Cylinder Co. (F-M-A)

MISCELLANEOUS

Janney Cylinder Co. (F-M-A)
(Nickel Alloys)

continued on page 88

F—Company does finishing
M—Company does machining
A—Company does assembly

FOR CLOSED-END SHAPES USE . . .
Low Cost Impact Extrusions

IMPACT EXTRUSIONS reduce machining costs and minimize scrap. Our cylindrical impact extruded parts' walls can be made thick or thin. Diameter sizes range from ⅜" O.D. to 2½" O.D. Choose from many aluminum alloys.

On large or small quantities, a phone call or letter will bring our representative to you. We have 20 years' experience in the impact field.

LEARN HOW TO CUT PRODUCTION COSTS FROM OUR BROCHURE.

IMPACT EXTRUSION PRODUCTS, INC.
PHONE: MA 1-1990-1
39 POWER HOUSE ROAD • ROSLYN, N. Y.

Circle No. 44 on Reader Service Card

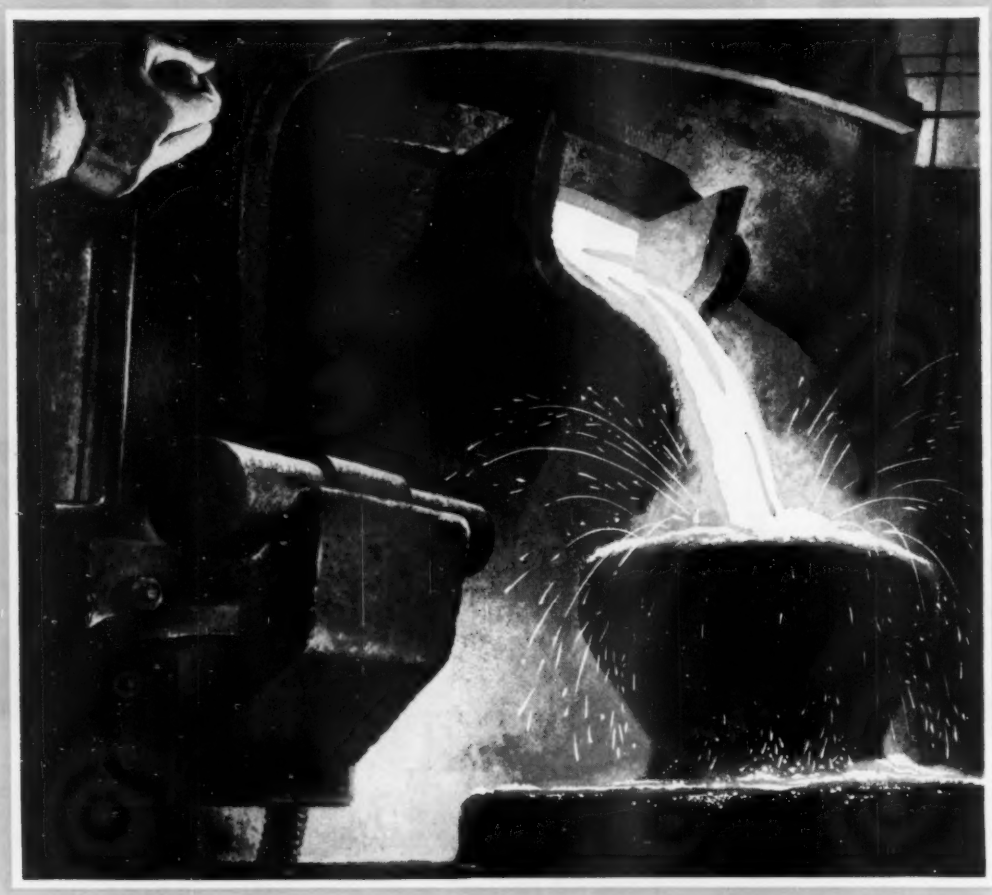
FLUID POWER DIRECTORY
MODERN OFFICE
How To Curb The Office Population Explosion
OCCUPATIONAL HAZARDS
10 WAYS TO SAVE THESE FEET
Material Handling Engineering
Hydraulics & Pneumatics
Material Handling Engineering
DIRECTORY & HANDBOOK
WELDING DESIGN & FABRICATION DATA BOOK
POWER TRANSMISSION DESIGN
Welding Design & Fabrication
The Refrigeration & Air Conditioning Business
SET UP FOR
POWER TRANSMISSION DESIGN HANDBOOK & DIRECTORY
Precision Metal Molding
Can Extensions Change Mass Buying Habits?
Handling & Shipping ILLUSTRATED

READER-PROFIT is the basic ingredient of a successful publication. When a magazine produces profitable returns on readers' time, it will also repay its advertisers' investment handsomely. This month marks our company's thirtieth anniversary. These 30 years have seen many changes: our publications have grown from one to 13, our employment from two to nearly 200, our aggregate circulation from less than 10,000 to half a million. But our basic publishing goal remains the same. We will continue to devote our efforts towards producing a profit for the man on whom our success depends: the reader.

THE INDUSTRIAL PUBLISHING CORPORATION

812 HURON ROAD · CLEVELAND 15, OHIO

OFFICES: NEW YORK • CHICAGO • LOS ANGELES • LONDON



Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

Ready... aim... NO FIRE!

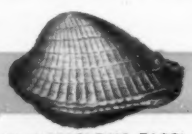
Take 10 high-temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus® Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment.

If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.



AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the **Irus** ellipticus.

SHELL IRUS FLUID 902

the low-cost, fire-resistant hydraulic fluid

SHELL

Circle No. 71 on Reader Service Card

EQUIPMENT

EXTRUSION PRESSES

Amer. Steel Foundries

Baldwin-Lima-Hamilton Corp. Ind. Equip. Div.

Birdsboro Corp.

Elmes King Div.

Feller Engr. Co.

Lake Erie Machinery Corp.

Lombard Corp.

Sutton Engineering Corp.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Foundry & Machine Co., The

Youngstown Mfg. Inc.

EXTRUSION PRESSES (IMPACT)

Erie Foundry Co.

Lake Erie Machinery Corp.

Verson Allsteel Press Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

RUN-OUT TABLES

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Becker Bros. Carbon Co.

Belco Ind., Inc.

Birdsboro Corp.

Clark Automation, Inc.

Feller Engr. Co.

Lake Erie Machinery Corp.

Lombard Corp.

Permanent Mold Die Co., Inc.

Sutton Engineering Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Foundry & Machine Co., The

Youngstown Mfg. Inc.

STRETCHERS

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Birdsboro Corp.

Clark Automation, Inc.

Feller Engr. Co.

Lake Erie Machinery Corp.

Lombard Corp.

Sutton Engineering Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Foundry & Machine Co., The

Youngstown Mfg., Inc.

STRAIGHTENERS

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Feller Engr. Co.

Lombard Corp.

Sutton Engineering Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

BILLET HEATERS

Ajax Magnethermic Corp.

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Belco Ind., Inc.

Birdsboro Corp.

Granco, Inc.

Grieve-Hendry Co., Inc.

Hevi-Duty Electric Co.

Lanly Co., The

Lindberg Engineering Corp.

Loftus Engineering Corp.

Carl Mayer Corp., The

Lombard Corp.

Morrison Engineering Corp.

W. S. Rockwell Corp.

Sunbeam Equipment Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

CUT-OFF SAWS

Ackerlind Steel Co., Inc.

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Birdsboro Corp.

Disston Div. H. K. Porter Co., Inc.

Lombard Corp.

Oliver Machinery Co.

Permanent Mold Die Co., Inc.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Wells Mfg. Corp.

Youngstown Mfg. Inc.

HEAT TREATING FURNACES

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Belco Ind., Inc.

Despatch Oven Co.

Granco, Inc.

Grieve-Hendry Co., Inc.

Hevi-Duty Electric Co.

Lanly Co., The

Lindberg Engr. Co.

Loftus Engineering Corp.

Lombard Corp.

Carl Mayer Corp., The

Morrison Engineering Corp.

W. S. Rockwell Co.

Sunbeam Equipment Corp.

Warwick Industrial Furnace & Eng. Corp.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

MELTING FURNACES

Ajax Magnethermic Corp.

Associated Foundry Services, Inc.

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Grieve-Hendry Co., Inc.

Hevi-Duty Electric Co.

International Foundry Supply Co.

Lindberg Engr. Co.

Loftus Engineering Corp.

Carl Mayer Corp., The

continued on page 98

Morrison Engr. Corp.

W. S. Rockwell Co.

Sunbeam Equipment Corp.

Warwick Industrial Furnace & Eng. Corp.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

BILLET SCARFING EQUIPMENT

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

BILLET CASTERS

Ajax Magnethermic Corp.

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

International Foundry Supply Co.

Lombard Corp.

Morrison Engr. Corp.

Permanent Mold Die Co., Inc.

Sonken-Galamba Corp.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Foundry & Machine Co., The

Youngstown Mfg. Inc.

MISCELLANEOUS

Clark Automation, Inc. (Conveyors, Cooling Tables, Storage Tables, Drill Presses)

DeBothezat Fans (Cooling Fans)

MATERIALS

DIE STEELS

Ackerlind Steel Co., Inc.

Ajax Steel & Forge Co. (H-11, H-12, H-13)

Allegheny Ludlum Steel Corp. (H-11, H-12, H-13)

Atlas Steel Limited

Bethlehem Steel Corp. (Hot Work)

Braeburn Alloy Steel Corp. (H-11, H-12, H-13)

Carpenter Steel Co., The (H-11, H-12, H-13, H-21)

Columbia Tool Steel Co. (H-11, H-12, H-13, H-13s, H-17, H-21, and H-26)

Crucible Steel Co. (H-11, H-12, H-13, P-20)

Fagersta Steels Pacific (H-12, H-13)

A. Finkl & Sons Co. (H-12 and specials)

Firth Sterling, Inc. (H-11, H-12, H-13, H-21, H-26)

Jessop Steel Co. (H-11, H-12, H-13)

Latrobe Steel Co. (H-12, H-13)

Uddeholm Co. of America (All types hot work steel)

U. N. Alloy Steel Corp. (All types)

Universal-Cyclops Steel Corp. (H-12, H-13, H-21, H-26)

Vanadium Alloys Steel Co. (H-12, H-13, H-21, H-23, H-25, H-26)

FIRE RESISTANT HYDRAULIC FLUIDS

Birdsboro Corp.

Celanese Corp. of America Chemical Division

E. F. Houghton & Co.

Monsanto Chemical Co.

Shell Oil Co.

Union Carbide Chemical Co., Div. Union Carbide Corp.

FLUXES

Associated Foundry Services, Inc. (Zinc, Aluminum, Lead, Brass)

Foundry Chemicals Co.

International Foundry Supply Co.

CARBON & GRAPHITE

Becker Bros. Carbon Co.

Grafo Colloids

Graphite Prods. Corp.

Industrial Colloids Co.

National Carbon Co.

DIE LUBRICANTS

Acheson Colloids Co.

Fiske Bros. Refining Co.

Grafo Colloids

Graphite Prods. Corp.

Industrial Colloids Co.

International Foundry Supply Co.

Kerns United Corp.

CRUCIBLES

Ajax Magnethermic Corp.

Becker Bros. Carbon Co.

BOLSTERS

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Benda Tool & Model Works

Birdsboro Corp.

Doss-Alloys & Industries, Inc.

Extrusion Dies, Inc.

Feller Engr. Co.

Grand Rapids Extrusion Die & Machine Co.

Lake Erie Machinery Corp.

Lake Park Tool & Die, Inc.

Lombard Corp.

Moczik Tool & Die Works

Permanent Mold Die Co., Inc.

Superior Extrusion Tool & Die Co.

U. N. Alloy Steel Corp.

Verson Allsteel Press Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

CONTAINERS

Ajax Steel & Forge Co. (Liners, Stems)

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Becker Bros. Carbon Co. (Canisters)

Birdsboro Corp.

Clark Automation, Inc. (Canisters)

Feller Engr. Co.

A. Finkl & Sons Co.

Lake Erie Machinery Corp.

Lombard Corp.

Mid-West Extrusion Tool & Die Co. (Canisters)

Moczik Tool & Die Works

Permanent Mold Die Co., Inc.

Superior Extrusion Tool & Die Co.

U. N. Alloy Steel Corp.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

DUMMY BLOCKS

Ackerlind Steel Co., Inc.

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Benda Tool & Model Works

Birdsboro Corp.

Doss-Alloys & Industries, Inc.

Extrusion Dies, Inc.

Feller Engr. Co.

A. Finkl & Sons Co.

Lake Erie Machinery Corp.

Lake Park Tool & Die Inc.

Lombard Corp.

Moczik Tool & Die Works

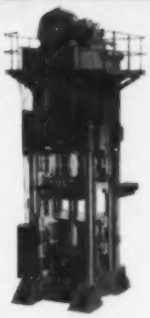
Permanent Mold Die Co., Inc.

Superior Extrusion Tool & Die Co.

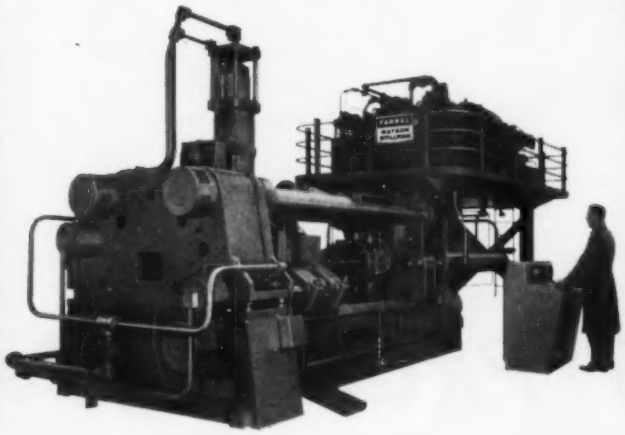
U. N. Alloy Steel Corp.

continued on page 92

extrusion presses for any purpose–



Lead presses for cable covering and rubber-hose vulcanizing.



Aluminum and brass extrusion presses.

based on 100 years of experience

The Farrel Watson-Stillman line of extrusion presses is as broad as your requirements. And, designs are based on 100 years of experience in building hydraulic equipment tailored to individual needs.

Company engineers have helped hundreds of manufacturers to find the right equipment for a specific job . . . to raise efficiency, boost production rates and increase profits. They are ready to start work on your problem today.

Ask for a quotation on a press for extruding any of the metals or materials listed below. Capacities range up to 6,000 tons in standard or special designs.

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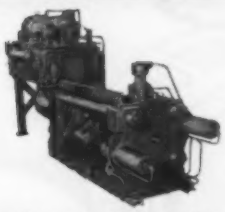
WATSON-STILLMAN PRESS DIVISION
570 Blossom Road, Rochester 10, N. Y.
Telephone: BUtler 8-4600
Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

FARREL
WATSON
STILLMAN

TYPES OF EXTRUSION PRESSES BUILT BY WATSON-STILLMAN
aluminum • brass • bronze • carbon • ceramics • copper cordite • crayon • graphite lead • lead pipe • magnesium phosphor bronze • silver alloys and precious metals • solder steel alloys and stainless • welding rod • wire and special alloys



Phosphor-bronze and silver-alloy presses.

Carbon-extrusion presses.

WS-73

Circle No. 84 on Reader Service Card

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

EXTRUSION DIES

Baldwin-Lima-Hamilton Corp. Industrial Equipment Div.

Doss-Alloys & Industries, Inc. (Impact and all tooling for impact presses)

Extrusion Dies, Inc.

A. Finkl & Sons Co.

Grand Rapids Extrusion Die & Machine Co.

Lake Erie Machinery Corp.

Lake Park Tool & Die, Inc.

Lombard Corp.

Mid-West Extrusion Tool & Die Co.

Moczik Tool & Die Works

Modern Tool & Die

Permanent Machine & Tool Co.

Permanent Mold Die Co., Inc.

Superior Extrusion Tool & Die Co.

Verson Allsteel Press Co.

Watson-Stillman Press Div. Farrel-Birmingham Co., Inc.

Youngstown Mfg. Inc.

METALS & ALLOYS

BILLETS

Allegheny Ludlum Steel Corp. (H-11, H-12, H-13)

Aluminum Limited Sales, Inc.

Aluminum Billets, Inc.

Aluminum Co. of America

Aluminum & Magnesium, Inc.

Aluminum Smelters, Inc.

Aluminum Smelters of New Jersey

Ampco Metal, Inc. (Beryllium & Bronze)

Anaconda Aluminum Co.

American Smelting & Refining Co. (Copper)

Apex Smelting Co.

Bay Billets, Inc.

Briel Industries, Inc.

Capitol Prods. Corp.

Carpenter Steel Co., The (H-11, H-12, H-13)

Corson Industries

Dixie Alum. Corp.

Dow Metal Prods. Co., The Div. of the Dow Chem. Co. (Aluminum & Magnesium)

Excel Smelting Corp.

Extrusion Ingot Co.

Fagersta Steels Pacific (All grades of tool & die steels)

Firth Sterling, Inc. (High temperature alloys)

Harvey Aluminum (Aluminum, Titanium, Sirconium)

Jessop Steel Co. (Carbon, Alloy and High Speed Tool Steels, & Constructional alloys)

Kawneer Co.

Lewin-Mathes Co. (Brass & Copper)

Kaiser Aluminum & Chem. Corp.

Olin Mathieson Chem. Corp.

Paragon Smelting Corp.

Pioneer Aluminum Inc.

Revere Copper & Brass, Inc.

Reynolds Metals Co.

Ronson Metals Corp. (Rare Earth Metals & Alloys)

Standard Magnesium Corp.

Superior Industries, Inc.

Titanium Metals Corp. of Amer. (Titanium)

Valley Metal Prods. Co.

WaiMet Alloys Co. (Iron, Nickel, & Cobalt base alloys)

continued on page 94

EXTRUDING PROBLEMS?

LET CLARK AUTOMATION HANDLE YOUR CARES

CLARK AUTOMATION INC
324 W. MAIN STREET
BELDING, MICH.
PHONE: 1555

WALKING BEAM

LET CLARK AUTOMATION handle your extrusions — from billet to package — ready for shipment.

Automatic billet conveyors • Cannisters • Automated run-out tables • Automated cooling tables • Stretchers • Automated saw conveyors • Multispindle drill presses

Clark's engineers help solve your extrusion problems right in your plant. Write. Get our specialists to help you.

Circle No. 24 on Reader Service Card

Press the button, that's all! The Ajax Magnethermic Billet Heater delivers a billet at exact temperature to the extrusion or forging press.

THE NEW NAME WITH THE FAMILIAR RING!

60 Cycle Induction Billet Heaters manufactured by AM... one of our many products for induction heating or melting of all types of metals.

"induction heating is our only business"

Ajax Magnethermic CORPORATION

GENERAL OFFICES
P. O. BOX 839
Youngstown 1, Ohio

TRENTON DIVISION
930 Lower Ferry Road
Trenton 5, New Jersey

YOUNGSTOWN DIVISION
3990 Simon Road
Youngstown 1, Ohio

Circle No. 3 on Reader Service Card

ARCHITECTURAL PRODUCTS

Adams & Westlake Co., The
Aluminum Air Seal Mfg. Co.
Aluminum Co. of America
American-International Aluminum Corp.
B & T Metals
Badger Aluminum Extrusions
Bristol Aluminum Co.
Calex Corp.
Canadian Mouldings Ltd.
Ceco Steel Products Corp.
Croft Metal Products, Inc.
Dixie Aluminum Corp.
Fay Machine Prod., Inc.
Michael Flynn Mfg. Co.
Fullview Corp.
General Extrusions, Inc.
Hillman Mfg.
Himmel Bros. Co., The
Jasco Aluminum Prod. Corp.
Div. Unexcelled Chem. Corp.
Kawneer Co.
Loxcreen Co., Inc., The
Mainline Extrusions, Inc.
Metal Masters, Inc.
Metal Trims, Inc.
Miller Industries, Inc.
National Aluminum Co.
North American Extrusions Corp.
Northeast Aluminum Inc.
F. A. Pilgrim Extrusions Co. Inc.
Pittsburgh Aluminum Alloys
Reynolds Metals Co.
Revere Copper & Brass, Inc.
Allan Scott Aluminum Corp.
Shower Door Company of America
Titus Metals Corp.
Trim Alloys Inc.
Valley Metal Prods. Co.
Youngstown Mfg., Inc.

EDGING

Aluminum Extruders, Ltd.
B & T Metals
Cardinal Extrusions
Colonial Alloys Co.
Dixie Aluminum Corp.
Extruded Aluminum Co., Inc.
Fay Machine Prod., Inc.
General Extrusions, Inc.
Jasco Aluminum Prod. Corp.
Div. Unexcelled Chem. Corp.
Kinkead Industries, Inc.
Metal Trims, Inc.
Royal Aluminum, Inc.
Trim Alloys Inc.
Valley Metal Prods. Co.

TRIM

Adams & Westlake Co., The
Aluminum Extruders, Ltd.
B & T Metals
William L. Bonnell Co., Inc. The
Brazeway, Inc.
Canadian Mouldings Ltd.
Cardinal Extrusions Co.
Colonial Alloys Co.
Colotrym Co., The
Detroit Gasket & Mfg. Co.
Dixie Aluminum Corp.
Extruded Aluminum Co., Inc.
Fay Machine Prod., Inc.
General Extrusions, Inc.
Hillman Mfg.
Jasco Aluminum Prod. Corp.
Div. Unexcelled Chem. Corp.
Kinkead Industries, Inc.
Light Metals Corp.
Loxcreen Co., Inc., The
Metal Trims, Inc.
F. A. Pilgrim Co., Inc.
Pittsburgh Alum. Alloys
Purpose Extruded Aluminum, Inc.
Royal Aluminum Inc.
Superior Industries, Inc.
Trim Alloys Inc.
Valley Metal Prods. Co.
Weather-Tite Div.
Aluminum Extrusions Corp.
R. D. Werner Co., Inc.

WINDOWS & DOORS

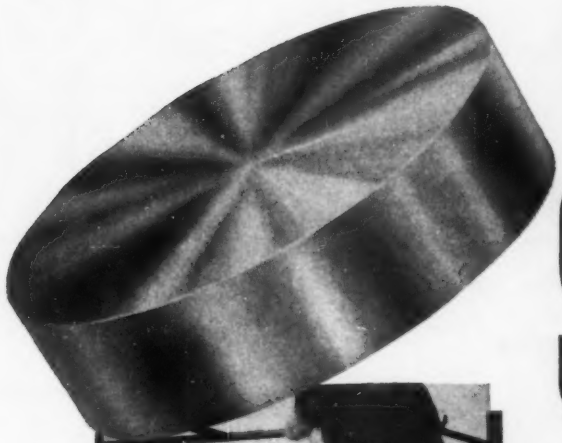
Adams & Westlake Co., The
Air Master Corp.
Alsco, Inc.
V. E. Anderson Mfg. Co., Inc.
Barberton Metal Products Co., Inc.
Bristol Aluminum Co.
Calex Corp.
Capitol Products Corp.
Ceco Steel Prods. Corp.
Croft Metal Prod., Inc.
Detroit Gasket & Mfg. Co.
Fentron Industries
Ferguson Extrusions, Inc.
C. M. Flynn Mfg. Co.
Michael Flynn Mfg. Co.
Fullview Corp.
Hercules Aluminum Corp.
Industrial Lamp Corp.
Jasco Aluminum Prod. Corp.
Div. Unexcelled Chem. Corp.

continued on page 96

Ultrasonic and Magnaflux Testing Assure **HOT WORK**

TOOL STEEL

*SO SUPERIOR it reduces scrap rate to zero!**



Every single disc is tested ultrasonically in two dimensions for defects. This technician is probing the periphery of a forged disc with ultrasonic equipment.

Here the disc is being tested on magnaflux equipment to find defects near the surface.

***** A Survey of all Bohler-U.N. tool steels delivered in the United States in the past two years shows that less than 1/10 of 1% has had to be scrapped due to defects. This remarkable proof of quality control shows why Bohler-U.N. forged discs and bars are becoming increasingly preferred for the most severe hot work tool steel applications. All thermal and mechanical properties required are met by the carefully balanced analyses of Bohler-U.N. steels.

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continued on page 98

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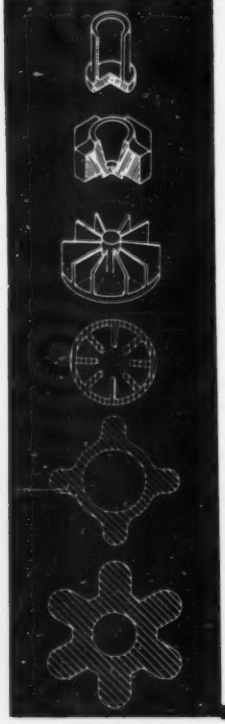

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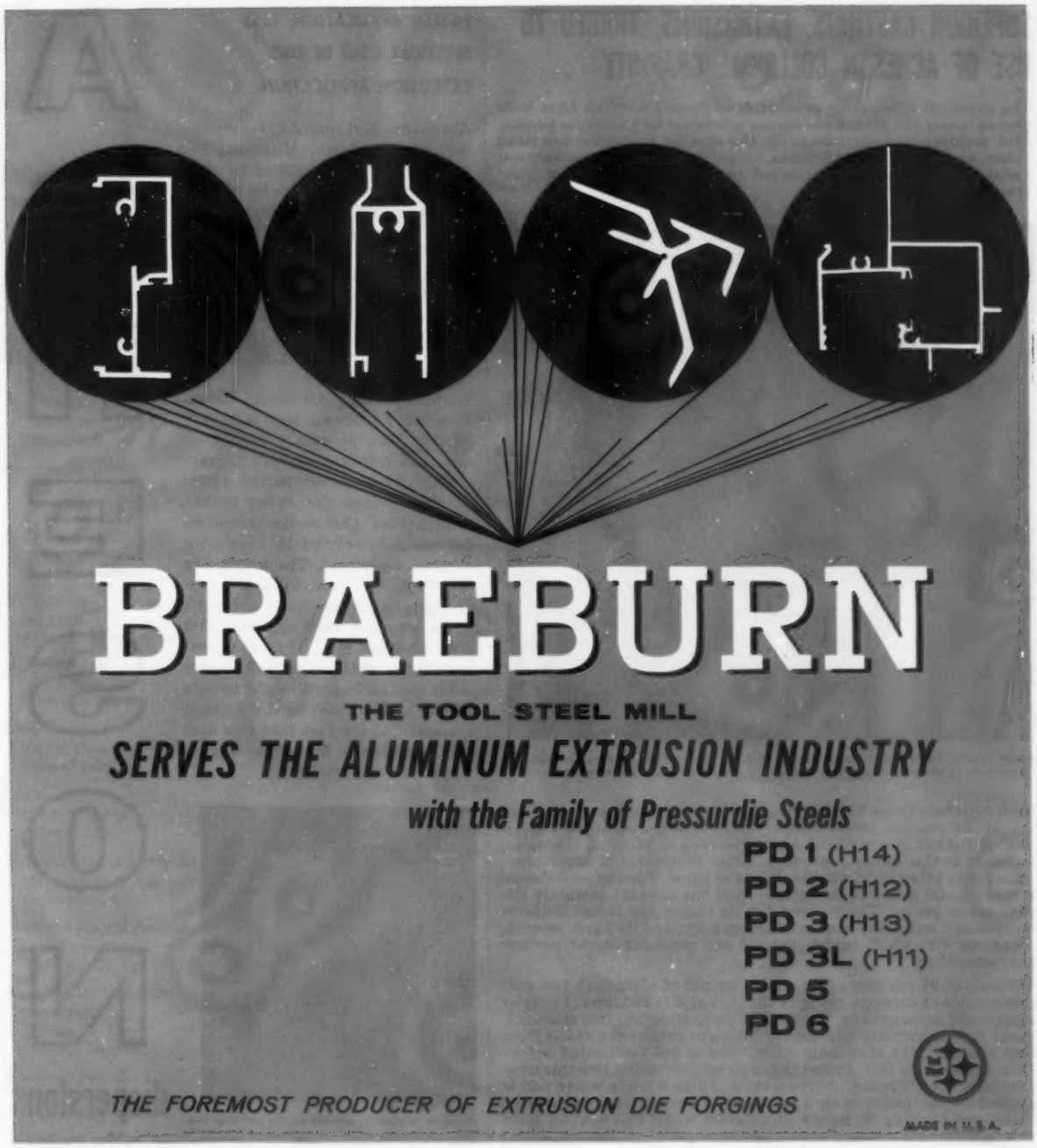

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SUPERIOR CASTINGS, EXTRUSIONS, TRACED TO USE OF ACHESON COLLOIDAL GRAPHITE

The excellent lubricating properties of these materials have been proven under the severe conditions attendant to aluminum permanent molding and extruding. In the specific examples described below, smoother surface finishes, longer die life, and more uniform metal flow are chiefly attributed to the application of a 'dag' brand dispersion.

Fewer rejects, consistently higher quality castings are obtained at Paragon Aluminum Corporation by spraying 'Prodag' on their permanent molds as a pre-pour wash.

Better surface finish with Prodag® permanent mold coating is just one of the reasons why Paragon Aluminum Corporation, a Division of Detroit Harvester Company located at Monroe, Michigan, switched to this Acheson product. After four years of experimentation with other mold washes, Paragon chose 'Prodag' — Acheson semi-colloidal graphite in water — and has used it constantly the past seven years. The reasons for its choice are these: uniform consistency, excellent heat-transfer quality, and its hard, smooth, tenacious film which resists flaking and provides easier parting characteristics.

With about 95 per cent of its annual output of more than two million pounds of castings going to the automotive industry, Paragon must insist upon quality. 'Prodag' helps to maintain this standard. Parts for convertible automobile tops are precision-molded from both 355 and 319 aluminum alloy. Molds are pre-heated before each day's run to 600° F. and the casting cycle maintains this temperature. The 'Prodag' dilution ratio is 1 to 4 parts water and is applied to the molds with a commercial spray gun. Aside from occasional touchup at points of greatest wear, this coating lasts through the entire run. Because of the physical contours involved in these comparatively small, light castings, they require rapid cooling in certain areas to insure uniform strength. The 'Prodag' coating — with its proven fast heat transfer ability — allows the castings to cool without breaks or pinholes. And by parting more easily, the high-finish castings which result have given Paragon Aluminum products wide acceptance in this demanding industry. If you have a metal casting problem, write direct for additional information contained in our Bulletin No. 425. Address Dept. PM-10

'dag', 'Aquadag', and 'Prodag' are trademarks registered in the U.S. Patent Office by Acheson Industries, Inc.

FASTER APPLICATION, LESS MATERIAL USED IN THIS EXTRUSION APPLICATION

Aluminum Extrusions, Incorporated, of Charlotte, Michigan, has realized a 30% savings in their material handling costs by the use of Aquadag® — Acheson colloidal graphite in water. They formerly had used an oil-graphite mixture which required a dilution ratio of 16 lbs. of graphite to a 55 gallon drum of oil. It was too slowly applied by swab and too coarse to effectively apply by spray.

With 'Aquadag', Aluminum Extrusions has a lubricant that is finer in particle size, permits wider coverage, and provides greater "sprayability". These minute particles pass freely through the spray nozzle, eliminating the costly downtime formerly involved in cleaning clogged equipment. The tough, dry film 'Aquadag' forms upon the evaporation of its water carrier, doesn't smoke or react when applied to hot dies and metals. This improves working conditions as well as extends die life. Important also to both die surfaces as well as the finished extrusion, is the fact that this durable, low-friction film allows easier, more uniform metal flow.

Acheson 'Aquadag', applied on die surfaces provides faster, more uniform application for Aluminum Extrusions, Incorporated.

If your problem is more effective lubrication under normally adverse conditions of extreme temperature, pressures, or abrasions, call in Acheson. In the meantime, write for your free copy of Bulletin No. 426.

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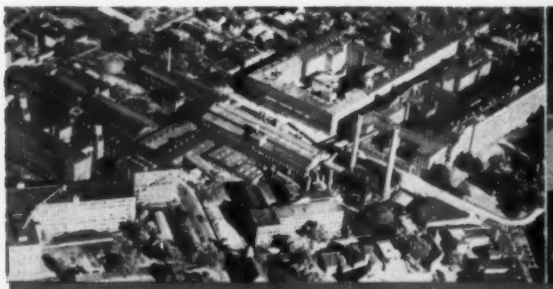
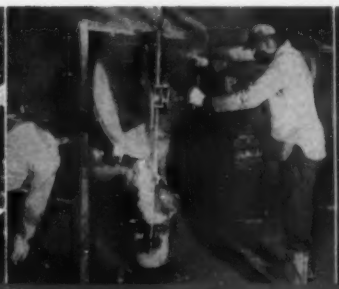


The American Hardware Corp. plant, New Britain, Conn.



Crucible Furnaces at American Hardware Corp.

Mr. Francis J. Wolfer, Foundry Superintendent

"After experience with indirect rocking arc and low frequency furnaces, we, at The American Hardware Corporation, switched to crucible melting to meet the stringent specifications of our cast products, and to reduce melting costs."

case history:

The experience of American Hardware who switched to crucible melting, after trying indirect rocking arc and low-frequency induction furnaces is ***not unique!***

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Flexibility is just as important: changing from one metal or alloy to another is just a simple matter of switching pots — no contamination, constant metal quality and reduced scrap!

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COrtlandt 7-6208

Rochester 4, New York
25 North St.
HAmilton 6-1490

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BRoadway 2-4128

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1345 W. Hurst Blvd.
ATlas 4-2642

Salt Lake City 1, Utah
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INgersoll 6-3406

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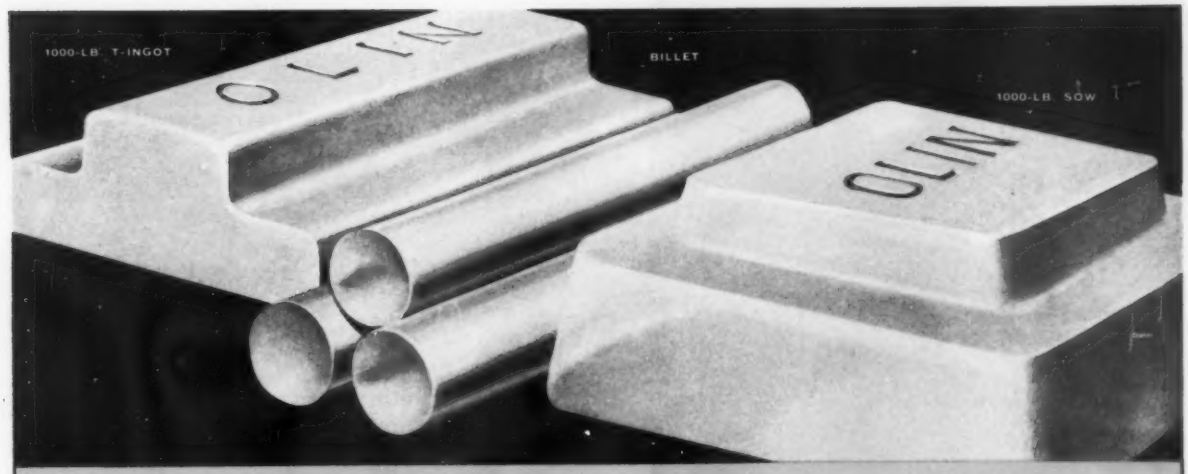
333 Taylor Ave.
ATwater 3-8101

Titanium Metals Corporation of America
233 Broadway
New York City 7, New York

continued on page 105



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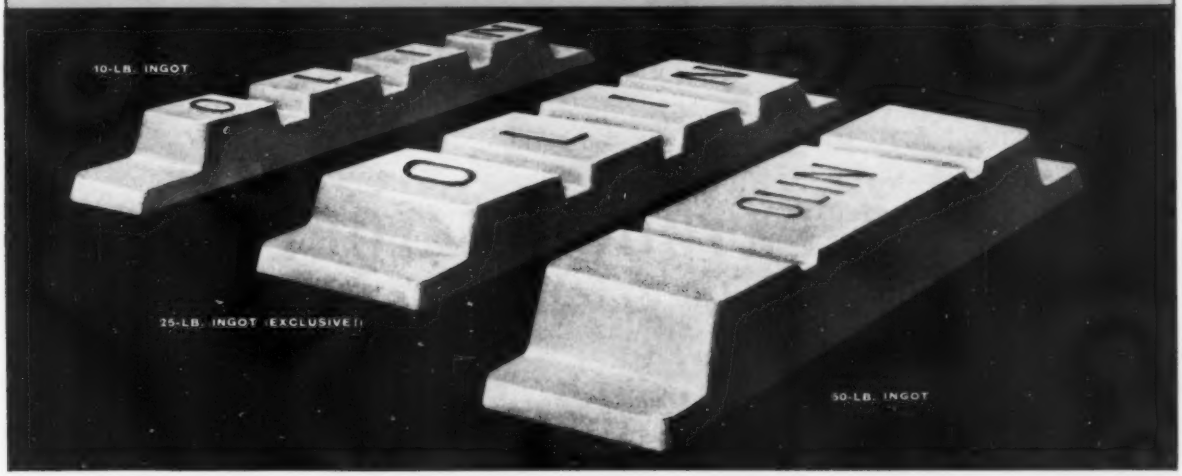
OLIN ALUMINUM PIG, INGOT AND BILLET



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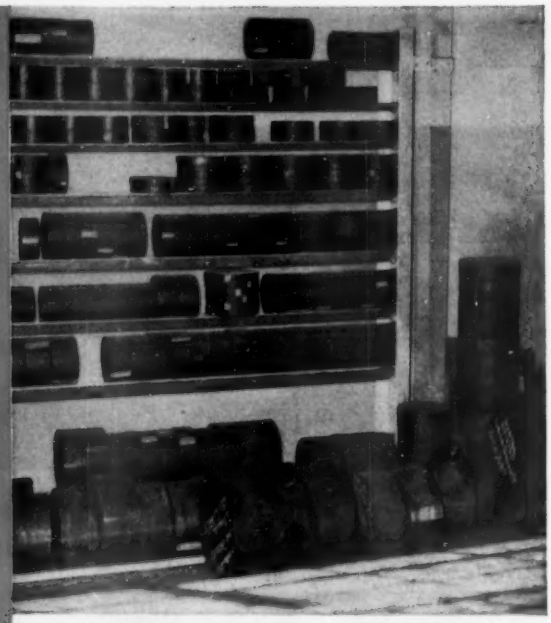

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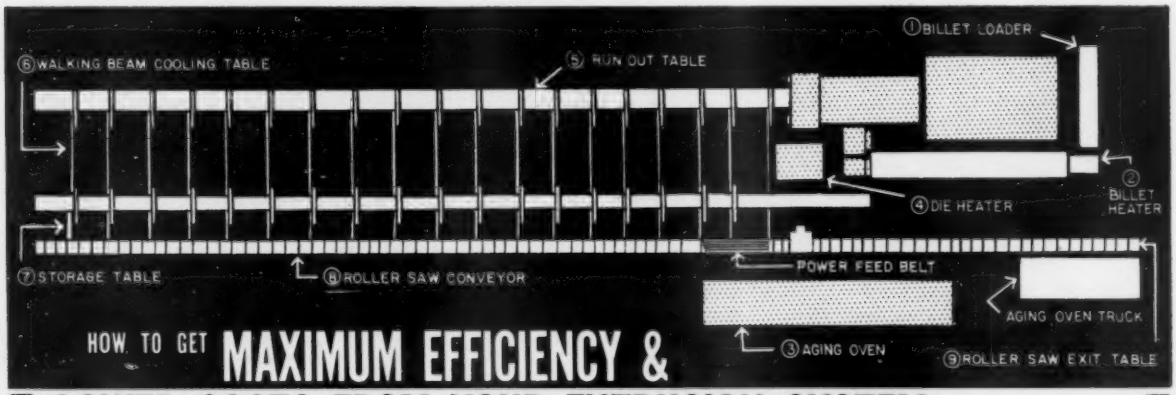

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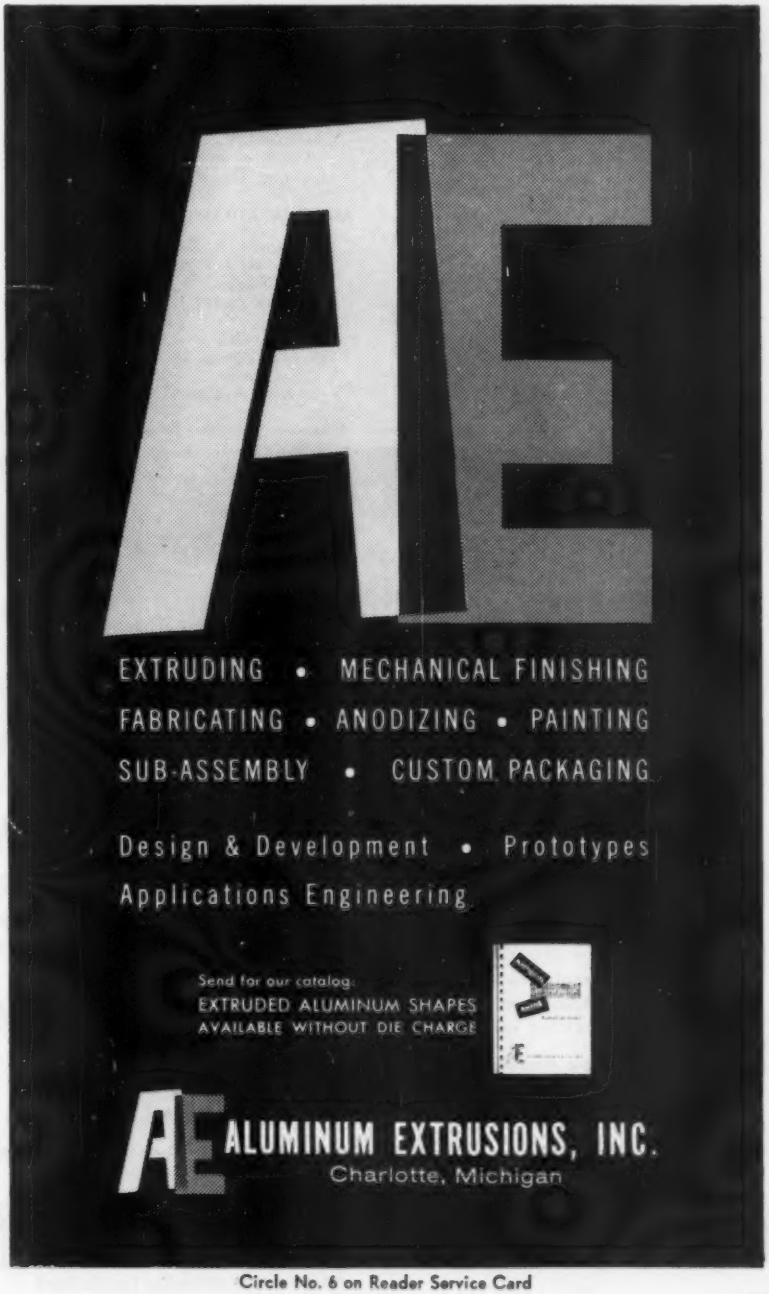

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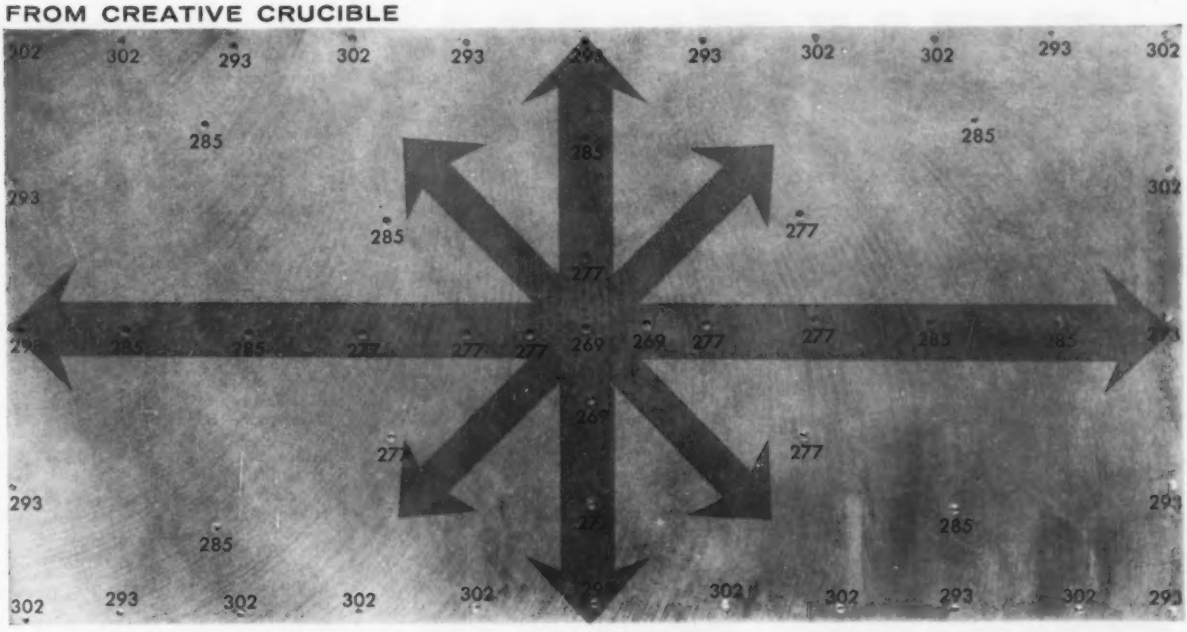

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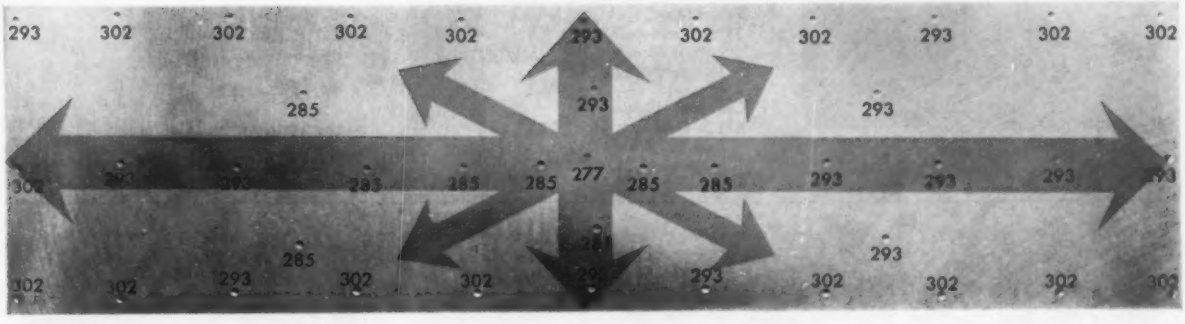

20" x 5"

CSM 2

with positive, high hardenability

Now you can make larger plastic molds and die casting dies—for longer runs—and get better finishes!

Notice the small hardness gradient—across the surface and from surface to center—of these typical blocks of prehardened CSM 2. This small gradient indicates the more uniform hardness of CSM 2—and assures you of at least 5 major benefits:

- more uniform polish from top to bottom of cavity
- greater resistance to washing at center or bottom of cavity
- more positive shut-off surface—particularly in internally landed molds and dies
- more uniform machining characteristics from top to center of cavity
- elimination of heat treatment of most plastic injection molds and zinc die casting dies in sections up to 14" to 15" thick.

Complete details on Crucible CSM 2—either prehardened or annealed—are readily available through local Crucible steel service centers. For data, call the center nearest you or write: *Crucible Steel Company of America, Dept. TI27, Pittsburgh 30, Pa.*

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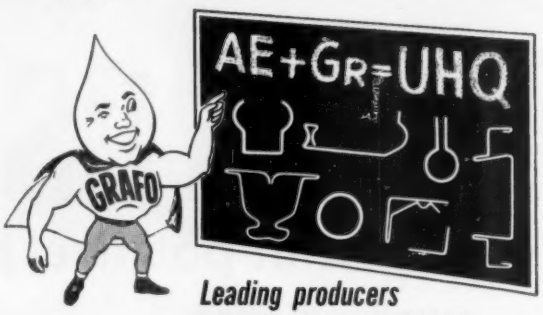
Happy answer to a problem!



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Many manufacturers of aluminum extrusions already know the basic answer. It's simply this: *Aluminum Extruding* plus *GRAFO* equals *Uniformly High Quality!*

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continued on page 112

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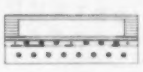

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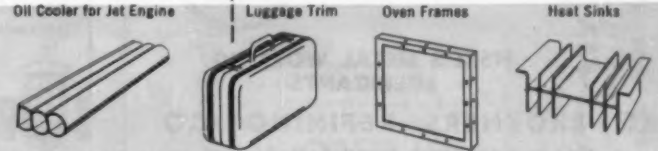

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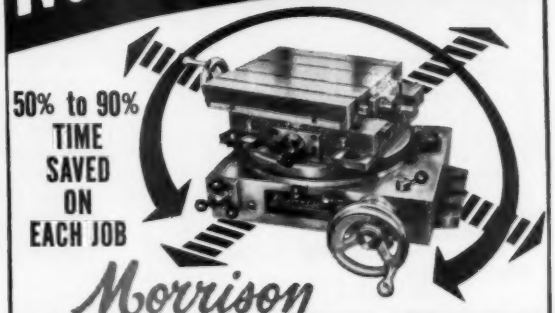

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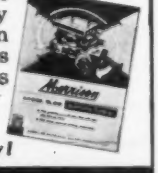

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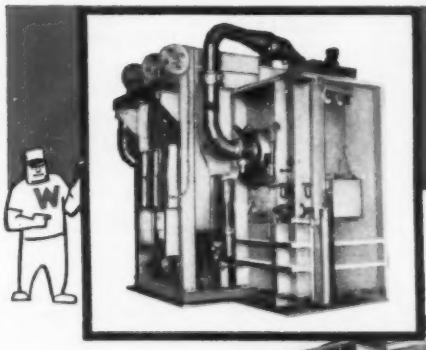
continued on page 114



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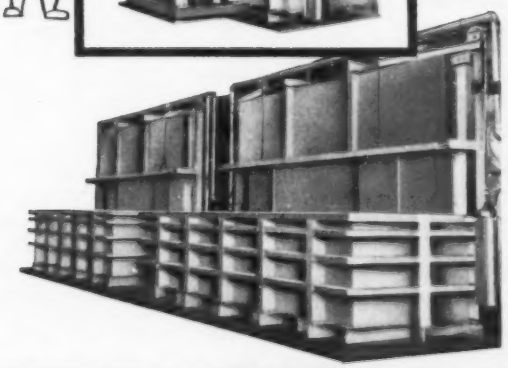

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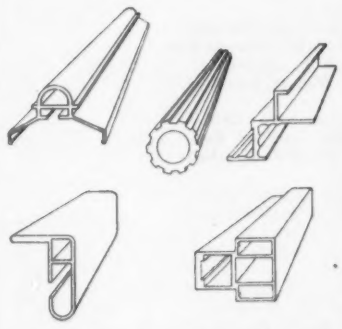

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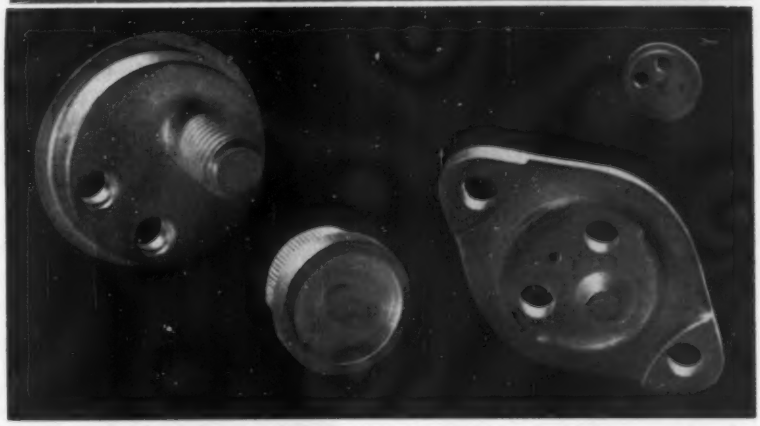

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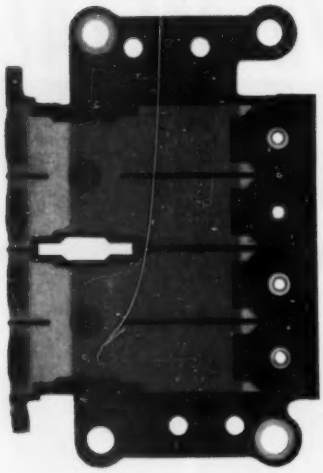

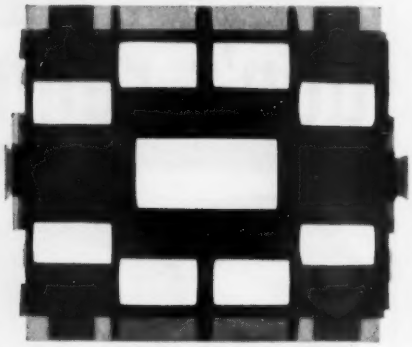

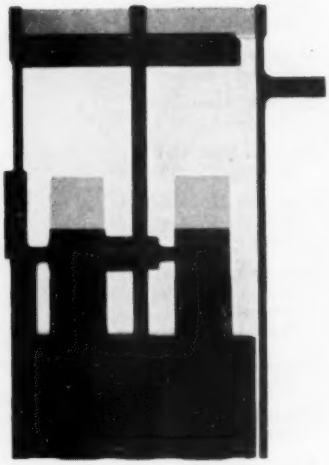

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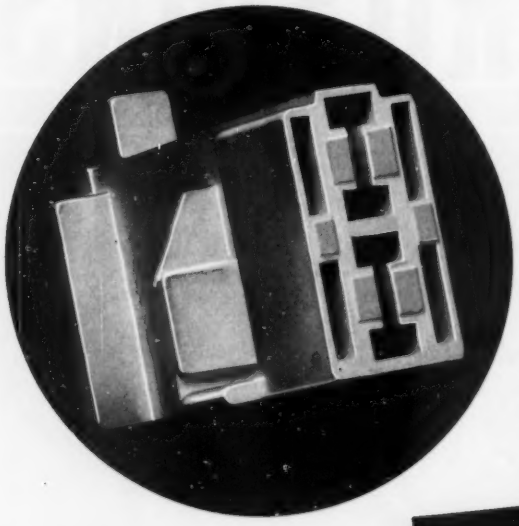

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This illustrated brochure tells the complete Gorham Electronics story. Write for your copy!

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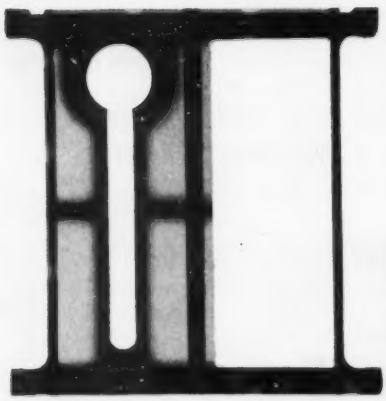

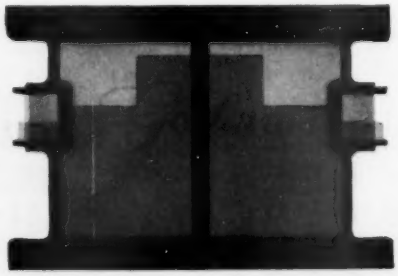

X-Ray photographs of airborne radar component castings by Gorham Electronics for Raytheon Company.

RAYTHEON

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(continued)

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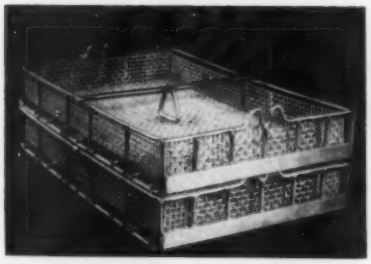

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"the HITCHINER way..."

...and non-machinable super alloys in INVESTMENT CASTING

These spray nozzles for highway striping paint sprayers were formerly machined out of cold rolled bar stock. When ordinary paint was used, these nozzles functioned satisfactorily. However, when ground glass was added to the paint for reflecting purposes excessive wear caused frequent replacement.

By "the HITCHINER way . . .", we were able to engineer the manufacture of this part by investment casting in a non-machinable type alloy exhibiting a very high degree of resistance to both wear and corrosion.

This change of alloy, which eliminated the need for frequent nozzle replacement, was made possible through investment casting because the required close dimensional tolerances and detail could be cast to size.

Through the wide freedom of choice in alloy, as well as through flexibility in design and the elimination of expensive machining operations, investment casting may possibly solve your metal parts manufacturing problems. Send us your sample or blueprint and find out with a Hitchiner "engineered quotation" — no obligation.

NO LIMITATIONS. From miniature ball bearing races to 20" Steam Turbine Impellers, "the Hitchiner way . . ." with investment castings can help you.

Send for our latest revised brochure and find out for yourself. It's free.

HITCHINER
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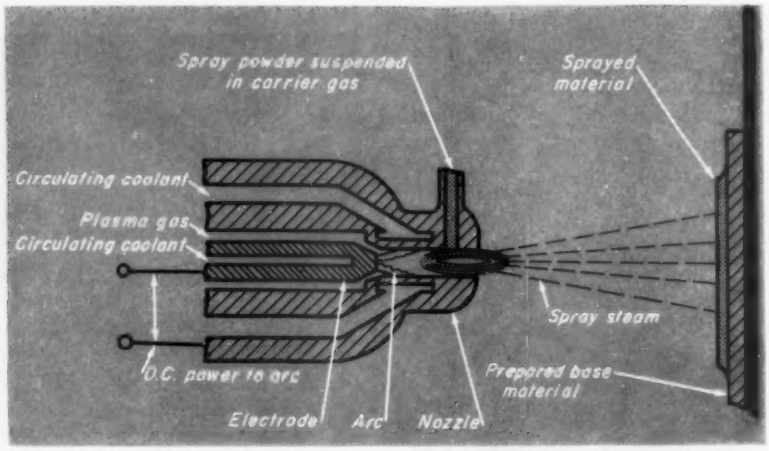

SCHEMATIC DIAGRAM of the Plasma Flame spray gun. Development of this process can represent a new, major market for all types of metal powders.

PLASMA FLAME POWDER SPRAYING

THE PLASMA SPRAY METHOD is a new technique for coating surfaces with high-melting-point powdered refractory materials. Industry uses this process to:

- Line crucibles with high-melting-point materials.
- Coat large vacuum tubes.
- Apply catalytic and protective coatings.
- Form thin walled shapes by spraying high-melting-point alloys over an aluminum mandrel, then leaching out the aluminum.

CHARACTERISTICS OF THE SPRAY

Physically and metallurgically, a plasma spray coating generally is better than conventional flame-sprayed coatings. The plasma sprayed surface has less porosity, improved bond and tensile strength, and for metals, smaller oxide content. Coating densities are easily controlled and run to 98% of theoretical. Pure tungsten and tungsten carbide can be applied with densities of 95% to almost any base material.

HOW IT'S DONE

In the plasma flame process, two separate nozzels bring a carrier gas and a plasma gas into a water-cooled spray gun (figure 1). The plasma gas, nitrogen with 5% to 10% hydrogen, is blown through an electric arc inside the spray gun. This arc disassociates and ionizes the gas to form a plasma flame. The carrier gas is 100% nitrogen and carries powdered metal through the plasma flame. The flame melts the powdered metal and blows it from the nozzle with great velocity.

The plasma flame produces temperatures as hot as 30,000°F. However, temperatures of 10,000°F to 15,000°F are high enough for normal spraying. The sprayed surface stays relatively cool.

The process uses inexpensive gases, converts electrical power to heat efficiently and the spraying equipment has a long life. The high temperature, continuous gas stream can be accurately controlled. Oxygen fuel gas equipment of the same heat output costs about twice as much. It takes very little training to operate the plasma spraying equipment.

SPRAYABLE MATERIALS

In general, the process can spray any material which melts without decomposing. Materials sprayed with standard equipment range from tungsten, with a melting point of 6170°F, to nickel, with a melting point of 2650°F.

There are many experimental powders available for plasma spraying. These powders are used mostly for research and development work at present. Their benefits, physical characteristics, and possible uses as spray coatings are not all known. Most of the materials now available can also be sprayed by methods other than the plasma flame technique. Other materials being developed for the process are tantalum, palladium, platinum, zirconium diboride, columbium, hafnium, vanadium carbides, and refractory borides of hafnium and cerium.

Material for this article was contributed by the Metallizing Engineering Co., Inc.

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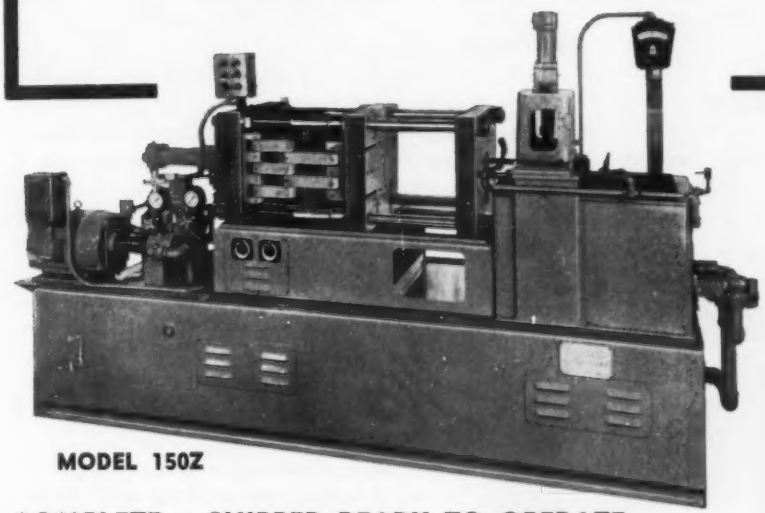

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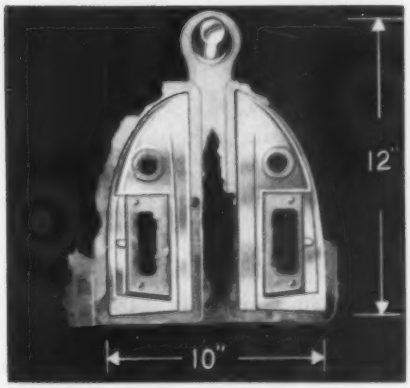
THE AMERICAN Model 150Z produces ASH TRAY HOUSINGS for CHRYSLER



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USEFUL LITERATURE, CATALOGS, MANUALS

Qualified readers may obtain any of these technical publications by circling the numbers on the Reader Service Cards facing Page 128

PROCESSES

145 Castings — HAMPDEN BRASS & ALUMINUM CO. — Brochure shows equipment and facilities for permanent mold and die casting.

146 Aluminum Casting — REYNOLDS ALUMINUM — 128-page technical manual answers your questions on casting aluminum.

147 Investment Castings — MISCO PRECISION CASTING CO. — External house organ tells how investment castings are used in gas turbine engines and accessories.

148 Investment Castings — LEBANON STEEL FOUNDRY — Bulletin describes the advantages of steel investment castings produced in ceramic molds.

149 Extrusions — MATTHEWS CORP. — 10-page booklet describes the design and production features of cold steel impact extrusions.

MATERIALS & EQUIPMENT

155 Cemented Carbides — ALLEGHENY LUDLUM STEEL CORP. — 12-page booklet gives details on design techniques and complete engineering data for the selection and application of Carmet grades when designing wear parts and die components.

156 Titanium Alloy — TITANIUM METALS CORP. — 32-page manual on the design, welding, and forming characteristics of beta titanium alloy.

157 Metal Powders — METALS DISINTEGRATING CO. — Technical data sheet lists a line of metal powders with engineering and application data.

158 Pneumatic Pump — DENISON ENGINEERING DIV. — Data on a new series or rugged 2500 psi vane pumps.

159 Resin Coated Sand — AURORA, METAL CO. — Brochure describes a resin coated sand for shell cores and molds.

160 Investment Casting Supplies — J. PINTER — Data sheet describes a self lubricating wax and investment material for investment casting steel.

161 Powder Metallurgy Equipment — PATTERSON-KELLY CO., INC. — 20-page bulletin has product descriptions and specifications for production blenders, vacuum tumble dryers and other powder metallurgy equipment.

162 Dry Lubricant — ALPHA-MOLYKOTE CORP. — Information on extreme-pressure molybdenum disulfide dry lubricant in stick form.

163 Lubricant Theory — ALPHA-MOLYKOTE CORP. — 24-page booklet on the theory and practice of lubrication by solids.

164 Sintering Furnace — HARPER ELECTRIC FURNACE CORP. — Bulletin shows an updated and expanded line of elevator furnaces for brazing, annealing, hardening, and sintering.

165 Brazing Furnace — C. I. HAYES, INC. — Literature describes a humpback conveyor furnace for high-temperature, hydrogen atmosphere brazing.

166 Furnaces — HEVI-DUTY ELECTRIC CO. — 12-page booklet describes double chamber, dry hearth aluminum melting and holding furnaces.

167 Melting Furnaces — HEVI-DUTY ELECTRIC CO. — Technical data on a new line of reverberatory melting furnaces for aluminum.

168 Tool Components — PIC DESIGN CORP. — Catalog lists over 500 stock tool and fixture components.

169 Material Tester — W. C. DILLION & CO. — Prices and engineering data on a portable machine for testing material strength.

170 Measurement Control — SCHAEVITZ ENGINEERING — 4-page catalog describes systems and components for monitoring minute changes in dimensions.

171 Gamatron — RADIONICS INC. — Data sheet describes a low cost gamatron with a capacity of over 3,000 curies of cobalt 60.

172 Spectrographic Analysis—LEBANNON STEEL FOUNDRY — Technical bulletin on spectrographic metallurgical control describes its applications to high alloy steel castings.

173 Hardness Testers — ADVANCE INDUSTRIES, INC. — Data sheets describe portable hardness testers which use a new loading principle.

174 Non-Destructive Testing — MAGNAFLUX CORP. — 4-page bulletin describes portable equipment for rapidly detecting cracks in iron and steel parts

175 Non-Destructive Testing — MET-L-CHEK CO. — Data sheets and prices on a penetrant-developer system for finding surface flaws in metal.

176 Dust Collectors — HAMMOND MACHINERY BUILDERS, INC. — Catalog of equipment for removing dust, chips, and mist from industrial atmospheres.

177 Thermocouples — THE BRISTOL CO. — 6-page bulletin tells how to select and order thermocouples.

178 Temperature Measurement — THE BRISTOL CO. — 56-page buyer's guide and user's manual for thermocouples and pyrometer accessories.

179 High Purity Alloys — UNIVERSAL-CYCLOPS STEEL CORP. — 12-page brochure describes the InFab process for producing high integrity mill products from refractory metals.

180 Ferrite Materials — INDIANA GENERAL CORP.—quarterly technical publication discusses the characteristics, uses, and plating of magnetic materials.

continued on page 122

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what's your problem?

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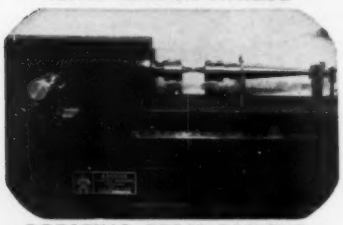
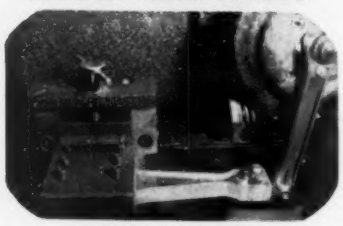


ROTATING BEAM FATIGUE



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USEFUL LITERATURE *(continued)*

181 **Furnace Brick** — KAISER REFRACTORIES & CHEMICALS DIV. — 8-page technical bulletin outlines the characteristics and applications for a new line of aluminum melting furnace brick and mortar.

183 **Cobalt Thermal Properties** — COBALT INFORMATION CENTER — 65-page booklet dealing with thermal shock and thermal fatigue of cobalt alloys and cermets.

FINISHING

185 **Blast Cleaning** — WHEELABRATOR CORP. — Brochure describes dual-purpose core knockout and blast cleaning equipment for castings.

186 **Vibratory Finishing** — SYNTRON CO. — 4-page brochure describes a vibratory barrel tumbling machine with variable vibration amplitudes.

187 **Rubberized Abrasives** — CRATEX MFG. CO. — 22-page manual on the use of rubberized abrasives gives case histories on typical applications.

188 **Color Filling** — ACROMARX CO. — Data sheet describes a machine for applying color decoration and lettering to metal parts.

189 **Metal Cleaner** — TURCO PRODUCTS, INC. — Bulletin describes an alkaline plater's cleaner that precleans and removes light rust in one operation.

190 **Deburring Media** — OAKITE PRODUCTS, INC. — Technical data on an abrasive media for deburring metals in tumbling barrels, especially recommended for severe cutting down operations.

191 **Painting Machine** — CONFORMING MATRIX CORP. — Brochure describes air operated, automatic reciprocating-type spray painting machines for spraying small and large areas.

192 **Vibratory Finishing** — LORD CHEMICAL CORP. — 12-page booklet shows a line of equipment for deburring and finishing by the vibratory method, explains the operating principle.

193 **Zinc Finishing** — LEA MFG. CO. — Data sheet on polishing wheel speeds, type of buff, and recommended abrasive compounds for the abrasive finishing of die cast zinc.

194 **Metal Finishing** — HANSON-VAN WINKLE-MUNNING CO. — 4-page bulletin describes their complete line of metal finishing products and processes.

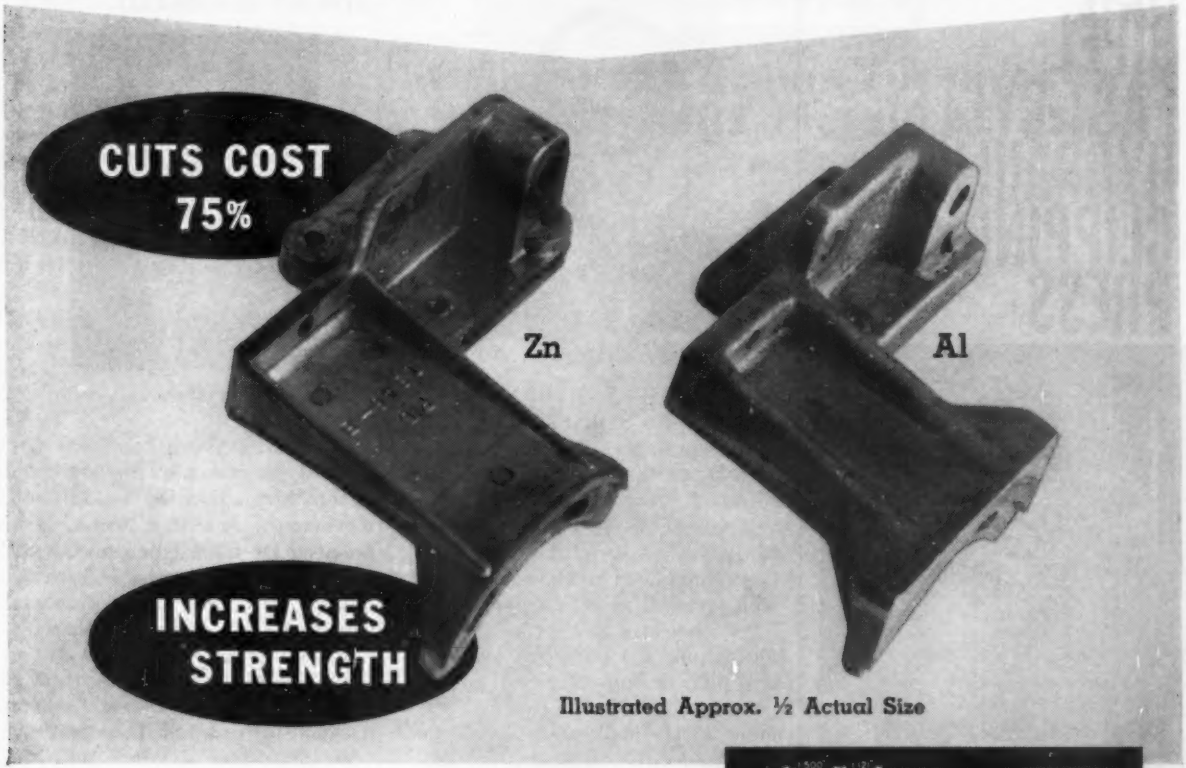
195 **Grinding & Polishing** — ACME MANUFACTURING CO. — 4-page catalog describes a complete line of flat surface grinding and polishing machines for finishing and deburring die castings and extrusions.

196 **Vacuum Plating** — CONSOLIDATED VACUUM CORP. — 28-page technical booklet on vacuum plating includes equipment descriptions and specifications, process information.

197 **Painting Machines** — CONFORMING MATRIX CORP. — Data sheet describes a high production automatic dial spray decorating machine and machines for fast part wiping.

198 **Srubbing Equipment** — HANSON-VAN WINKLE-MUNNING CO. — 2-page bulletin describes various types of strip mill scrubbing equipment.

Zinc Replaces Aluminum



Zinc Die Cast Mounting Bracket Eliminates 21 Machining Operations

When made from an aluminum casting this mounting bracket for a commutator costs $4.00. Now made from a zinc die casting it costs $1.00, which justified the die cost in the first 1,000 pieces. The cast part has greater tensile strength, a smoother surface and is less bulky than its aluminum predecessor.

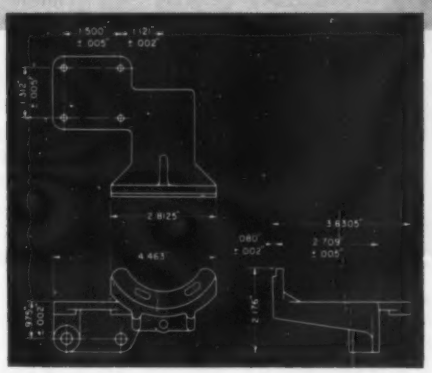
Plan to Convert Eight More Parts to Zinc

The mounting bracket is made for the Defiance Machine & Tool Co. of St. Louis by A. B. Mueller Co. In view of the successful results, Defiance plans to switch eight more parts from aluminum to zinc.

Secondary Operations Eliminated

After the usual clean-up, the aluminum casting required milling the working surface and two slots; milling the radius in two directions; machining fine mounting surfaces, drilling and tapping six holes. Machining the radius was very expensive as close tolerances were involved.

The zinc die casting required only a simple trimming. Holes and slots are cored and the radius is made directly from the die construction. "As-cast" tolerances are held ± .002 on the mounting surfaces and within ± .005 for the hole spacing.



DIE CASTING
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ZINC, the metal...

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The Preferred Zinc

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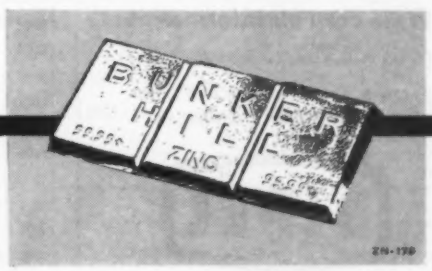

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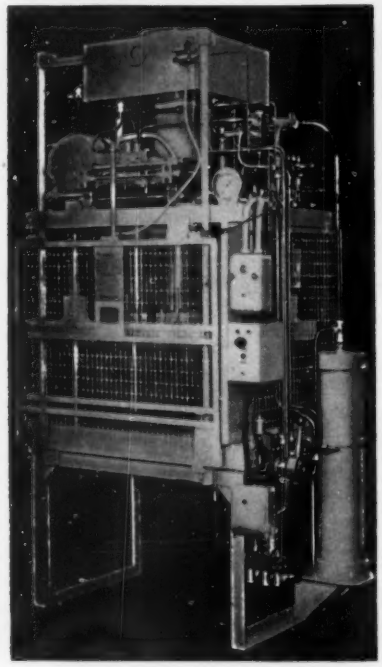

A brand new 34-ton clipping press from BIPEL... world renowned for their plastic molding presses! This special purpose hydraulic unit offers a faster approach (600 ins./min.), and a fast advance through the work (40 ins./min.), at full tonnage. Dry Cycle Time only 3 seconds. Semi-automatic or manual control... with mesh guards for maximum operator safety. A flexible, efficient, clean-trimming unit.

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INDUSTRY NEWS (*continued*)

SHINSKY

ALUMINUM EXTRUSIONS, INC. PROMOTES SHINSKY

The promotion of Richard L. Shinsky to the newly created position of manager of product development of Aluminum Extrusions, Inc., Charlotte, Mich., has been announced by Dennis G. Maxwell, general sales manager.

As chairman of AE's Product Development Committee, Shinsky will plan and direct a program to develop new uses for extruded aluminum. He will also direct the activities of the company's consulting engineer and supervise the AE model shop.

Mr. Shinsky, formerly AE sales engineer, will continue to provide application engineering assistance to the company's field sales organization.

AE is a custom producer of fabricated extruded aluminum parts for a wide range of industrial concerns from coast to coast.

PALMER NAMED FIELD SALES MANAGER

Robert M. Palmer was recently named Field Sales Manager of Hevi-Duty Electric Company according to Elton E. Staples, President of Hevi-Duty.

Palmer, who has been with the Hevi-Duty organization for thirteen years, started his career as a Sales Engineer in the firm's Eastern District Sales Office. For the seven years prior to his appointment as Field Sales Manager, he was Manager of Hevi-Duty's Eastern District Sales Office in New Jersey. In his new capacity Palmer will be responsible for all operations of Hevi-Duty District Offices and representatives.

NYBURG APPOINTED

NYBURG

James K. Nyburg has been appointed general sales manager of Easton Metal Powder Co., Div. of American Mannex Corp., announced Dr. G. Wagner, president. He will coordinate sales and marketing plans for the divisions covering molding, cutting, and scarfing powders as well as powders for special applications. Nyburg was formerly sales manager of Republic Steel Corp. Metal Powder Div.

REJECTS knocking your profits for a loop?

The alloys you're using may be at fault— For good casting results your alloys must fulfill a considerable number of specific requirements, PLUS all the particular qualities to meet YOUR casting needs.

See how HB&S start-to-finish quality controls guarantee alloys always 100% "on spec" . . . write TODAY for Henning's "Reference Book and Guide on Zamak (Zinc Base) Die Casting Alloys". It's yours for the asking.

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PRECISION METAL MOLDING

METAL SHOW MPIF PROGRAM

MPIF has announced the program for their Metal Show technical session at the Bellevue-Stratford Hotel, Philadelphia, Oct. 19. The following papers will be presented: Sintered Brass, Ceramic Molds, Thin Walled Cones, and Iron Powder by Fluidized Bed Method.

Powder Metallurgy Sessions of the AIME Technical Program are at 9:00 A.M. and 2:00 P.M. on Oct. 20. Brief abstracts of the following papers will be presented: Ultrafine Metal Powders, Effect of Particle Size of Ni and MgO Powder Properties, Processing Variables vs. Properties for Liquid-Phase Sintered High-Temperature Alloy, Pressing Temperature vs. Agglomeration of MgO in Dispersion-Strengthened Ni-MgO Alloy, Refractory-Coated Fine Metal Powders, and Metal-Bonded Graphite.

The afternoon session papers are: Sintering of Oxide Particles Produced by Calcination of Salts, Early Stages of Sintering, Ni Activated Sintering of W Powder, Growth of Al_2O_3 in Ni Matrix, and Shrinkage of Cu Compacts.

BRADBURY JOINS HOEGANAES

BRADBURY

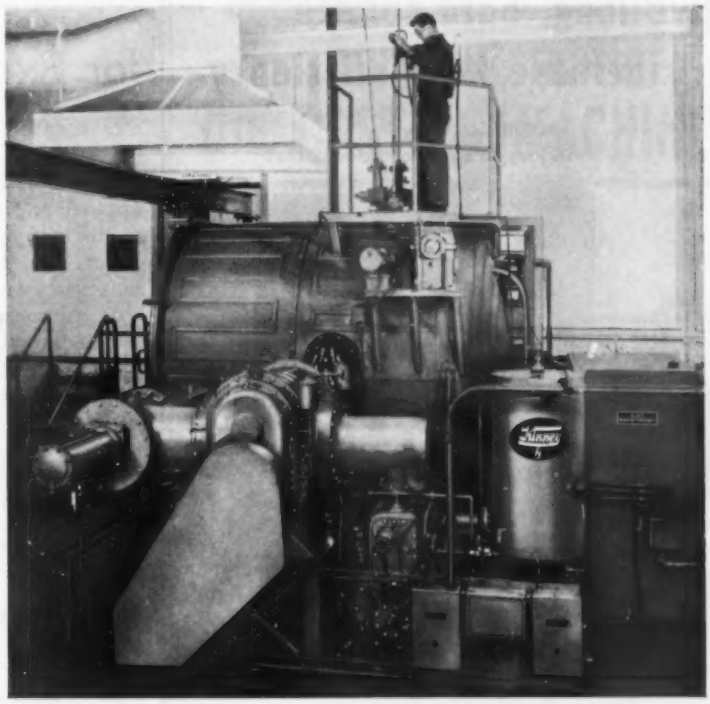
Samuel Bradbury, formerly Product Specialist, of the Tabletting Equipment Division, F. J. Stokes Corporation, has joined Hoeganaes Sponge Iron Corporation as Manager, Sales Engineering.

Bradbury graduated from Lehigh University in 1938 where he majored in Geology. He joined the F. J. Stokes organization in 1939 and for the past 11 years has specialized in the field of powder metallurgy.

more industry news on page 132

Kinney®

Builds the Vacuum Furnaces to Produce PURE Metals BETTER!



Above, you see a highly versatile KINNEY Vacuum Furnace now in operation at the Watertown Arsenal, Watertown, Mass. In addition to its primary function of Melting and Casting high purity metals, it may be used for degassing atomic materials, sintering carbon molds and alloying reactive metals.

It handles loads up to 1000 lbs. of steel (2200 lbs. uranium) with provision to pour in increments at automatically controlled pouring stations, or pour a full load in 60 seconds. Two interchangeable melting coils, for full capacity and half capacity loads, each provide temperatures up to 3400°F. The pumping system can evacuate the 8' diameter x 11' chamber from atmosphere to 5 microns in 7 minutes and can attain ultimate pressure in the order of .5 micron.

This Furnace is one of a large family of KINNEY designed Furnaces available for Vacuum Melting, Alloying, Refining, Sintering, Heat Treating, Annealing, Welding and Brazing. Details of function, construction and operation may be had by consulting a KINNEY High Vacuum Furnace specialist. Write today!

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DFC Furnaces

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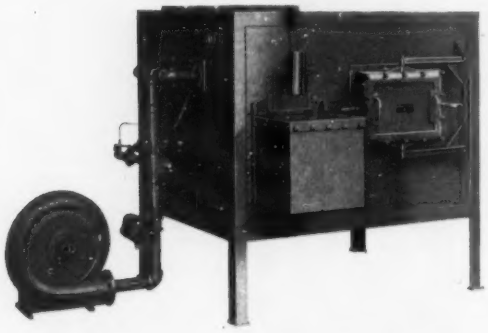
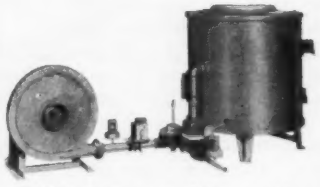


REVERB-O-MELTER, reverboratory aluminum melting furnace, available in either stationary or tilting types, gas-fired. Separate charging and ladling buckets allow simultaneous operations, built-in access door for fluxing and puddling. Used for die casting, permanent mold casting, conveyorized production of small sand castings.

Tangential firing— no crucible hot spots!



Rugged crucible and pot type, stationary melting furnace, for melting at temperatures up to 2200° F. in graphite crucibles. Gas or oil fired; adaptable to manual or automotive temperature control as well as flame safety equipment. For melting non-ferrous metals: copper, brass, bronze, gold, silver, etc.

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DFO-14

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DESIGN

for Extruded Stainless Steel

IF EXTRUDED STAINLESS steels are to be applied as widely as possible it is essential that all of the extruders meet certain dimensional tolerances. When these tolerances are held, the design engineer may specify extruded sections with the full knowledge that any source can be used.

Standards for extruded low alloy and carbon steels have been agreed upon by the industry and these dimensional standards and tolerances were published in PRECISION METAL MOLDING in the May, 1960 issue, pages 49 and 50.

Extruders of stainless steels have also agreed upon standard dimensional tolerances. These tolerances

SECTION TOLERANCES:—

Dimensions Under 1"	Total Tolerance .040"
Dimensions 1" to 3" Inclusive	Total Tolerance .062"
Dimensions Over 3" to 4" Incl.	Total Tolerance .093"
Dimensions Over 4"	Total Tolerance .125"
Angularity Tolerance	Plus and Minus 2°

CORNER RADII TOLERANCES:—

300 Series Stainless Grades	1/8" Maximum
400 Series Stainless Grades	3/32" Maximum

Sharp corners cannot be produced. Maximum corner radii may be specified as indicated above, or, if desired, larger radii can be furnished.

CAMBER TOLERANCES:—

Camber is the greatest deviation of a side from a straight line. Measurement is taken on the concave side of the bar with a straight edge. Unless otherwise specified, extruded bars shall be furnished straightened to the following tolerances:—

1/8" in any 5', but not to exceed 1/8" x No. of Ft. in Length

TOLERANCES

should always be used if the most uniform and least costly parts are to be bought. When any departure from these standards is essential the designer should consult one of the extruders of stainless steel to determine if the change is possible and how much it will change the cost of both tools and the finished extrusions. In many cases it will be found that it is less costly to do a minor machining operation on the extruded parts than to pay for much closer dimensional tolerances from the mill.

The following dimensional tolerances for hot extruded special sections in stainless steel have been furnished by The Babcock & Wilcox Company.

LENGTH TOLERANCES:—

Machine Cut After Straightening.

Width of Section (Inches)	Length Tolerances (Inches) To 12 Ft. Incl. Over	Under	Over 12 Ft. to 25 Ft. Incl. Over	Under
To 3" Incl.	1/8	0	3/16	0
Over 3" to 6" In.	3/16	0	1/4	0
Over 6"	1/4	0	5/16	0

TWIST TOLERANCES:—

Twist is the amount of spiraling in an extruded bar and is measured by the height of the high corner from a flat reference base.

Width of Section	Rise in 5 Feet
1/2" to 1-1/2" Inclusive	1/8"
Over 1-1/2" to 4" Inclusive	3/16"
Over 4" to 6-1/2" Inclusive	5/16"

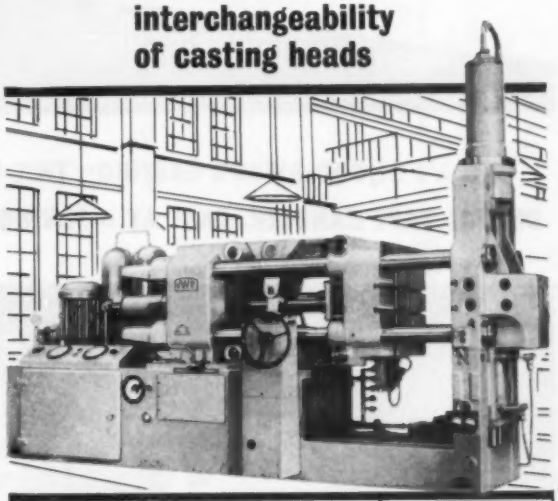
FILLET RADII TOLERANCES:—

1. Where included angle is 90° or greater—1/4" Maximum.
2. Where included angle is less than 90°, fillet radius is to be determined upon application to mill.

NEWEST, GREATEST ADVANCE for high speed injection die casting

VWF four column fully automatic DIE CASTING MACHINES

featuring
interchangeability of casting heads



TYPE	NOMINAL LOCKING PRESSURE (Metric Tons)	MAXIMUM LOCKING PRESSURE (Tons)
DMK/50	50	75
DMK/100	100	150
DMK/200	200	300
DMK/400	400	600
DMKh/630	630	800
DMKh/800	800	1200

Acclaimed throughout Europe because they're setting outstanding performance records! The largest West German automobile manufacturer, for example, uses many of these rugged machines to achieve highest output on intricate, thin wall castings with ease and economy of operation—*uniform* castings that have high density and strength, low porosity and smooth surfaces that require a minimum of secondary machining. They find that the DMKh/800 actually permits locking pressures of 1200 tons on typical operations.

Built to meet the most intricate and stringent requirements of industry, VWF machines have a large power reserve and are suitable for all non-ferrous alloys. Interchangeability of the casting heads permits two process setups in any particular instance—for the cold chamber method with either vertical or horizontal pressure chamber, or for the hot chamber method. Selection is determined by the shape of the workpiece, material and special requirements of the casting.

Six models available with specific injection pressure from 1000 to 33,000 lbs/sq/in. Maximum weight per shot in aluminum from 1 to 33 lbs depending on model. For complete details write now for Bulletin DD-6.

MANUFACTURED BY
Vereinigte Werkzeugmaschinenfabriken AG, West Germany

VWF
SOLE AGENT IN THE UNITED STATES

ERIC P. CAHN
225 LAFAYETTE STREET, NEW YORK 12, N. Y.
TELEPHONE: WALKER 5-5203

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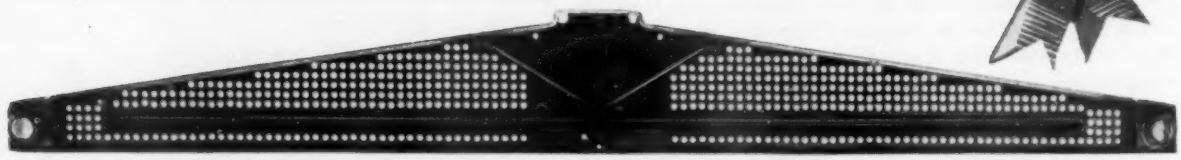
SALUTES

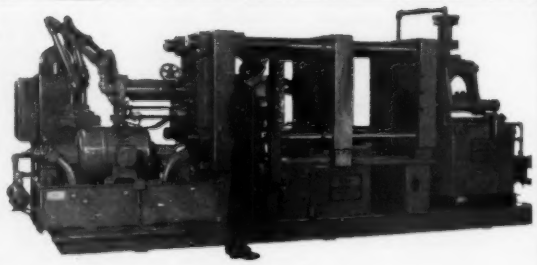
A&A die casting company

. . . top winner of the New Jersey Zinc Co.

"Zinc Die Casting of the Year" Award



A & A's $1,000-AWARD CASTING—THIS 6-LB. 32-INCH VACUUM CHAMBER FOR AMPEX DIGITAL TAPE HANDLER. CAST AT A SAVING OF 95% OVER PREVIOUS PRODUCTION METHOD.



Hydraulically operated plunger gooseneck model BH-600, with strain gage proven die locking pressure of 600 tons, produced the grand prize winner for A & A.

CONGRATULATIONS TO A & A on their achievement of manufacturing this exceptional wave guide die casting. The casting, having an unprecedented 515 cored holes, was made to the most exacting requirements and tolerances. Two slots running almost the entire 32 inches of casting length are only .007 inches wide, and a flatness within .002 inches end to end is achieved as specified. A perfect cast finish is also a must, as the part is hard chrome plated for wear resistance.

KUX IS PROUD, TOO—TO HAVE HELPED! To solve this and other difficult problems in precision die-casting, Victor Anderson and John Allen, founders of A & A Die Casting Company make almost exclusive use of many different models and sizes of Kux machines with their built-in engineering superiorities.

Write for full details of the 28 all-new KUX models illustrated in the latest KUX Die Casting Machine Catalog.

KUX MACHINE CO. • 6725 NORTH RIDGE • CHICAGO 26, ILLINOIS

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2	20	38	56	74	92	110	128	146	164	182	200	218	236	254	272	290	308	326	344	362	380	398
3	21	39	57	75	93	111	129	147	165	183	201	219	237	255	273	291	309	327	345	363	381	399
4	22	40	58	76	94	112	130	148	166	184	202	220	238	256	274	292	310	328	346	364	382	400
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7	25	43	61	79	97	115	133	151	169	187	205	223	241	259	277	295	313	331	349	367	385	403
8	26	44	62	80	98	116	134	152	170	188	206	224	242	260	278	296	314	332	350	368	386	404
9	27	45	63	81	99	117	135	153	171	189	207	225	243	261	279	297	315	333	351	369	387	405
10	28	46	64	82	100	118	136	154	172	190	208	226	244	262	280	298	316	334	352	370	388	406
11	29	47	65	83	101	119	137	155	173	191	209	227	245	263	281	299	317	335	353	371	389	407
12	30	48	66	84	102	120	138	156	174	192	210	228	246	264	282	300	318	336	354	372	390	408
13	31	49	67	85	103	121	139	157	175	193	211	229	247	265	283	301	319	337	355	373	391	409
14	32	50	68	86	104	122	140	158	176	194	212	230	248	266	284	302	320	338	356	374	392	410
15	33	51	69	87	105	123	141	159	177	195	213	231	249	267	285	303	321	339	357	375	393	411
16	34	52	70	88	106	124	142	160	178	196	214	232	250	268	286	304	322	340	358	376	394	412
17	35	53	71	89	107	125	143	161	179	197	215	233	251	269	287	305	323	341	359	377	395	413
18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360	378	396	414

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- ☐ Investment Castings
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1 **Die Lubricant**—Acheson Colloids Co.—Technical bulletins—on colloidal graphite water base lubricants for use in dies and other abrasive, high temperature and pressure applications.

2 **Stamping & Marking**—Acromark Co.—Catalog—and price list on a line of stamping and marking machines.

4 **Tool Steels**—Allegheny Ludlum Steel Corp.—Booklet—describes the Steelector method for selecting the tool steel that meets your particular requirements.

6 **Extrusions**—Aluminum Extrusions, Inc.—Catalog—shows extruded aluminum shapes availables without die charge.

8 **Die Casting Alloys**—American Smelting & Ref. Co.—Technical data—on electrolytically refined high grade zinc and other die casting alloys.

11 **Investment Castings**—Arwood Corp. 44-page booklet—"Practical Guide to Investment Casting."

13 **Die Casting Machines**—B & T Machinery Co.—Specifications—on a line of zinc and aluminum die casting machines.

14 **Extrusion Press**—Baldwin-Lima-Hamilton Industrial Equipment Div.—Detailed information on the Loewy 1500-ton extrusion press.

19 **Clipping Press**—B.I.P. Engineering Ltd.—Technical data—on a 34-ton, fast cycle, hydraulic clipping press.

20 **Sinterings**—Bunting Brass & Bronze Co.—Technical handbook—on the engineering and production of sintered metal parts.

25 **Die Casting Machines**—Cleveland Automatic Machine Co.—Specifications—on a complete line of die casting machines.

27 **Furnaces**—Denver Fire Clay Co.—Technical data—on a complete line of furnaces for testing, melting, assaying, heat treating and other special uses.

28 **Die Casting Dies**—Detroit Mold Engineering Corp.—170-page catalog—describes standardized die components which reduce design time and cut die construction costs.

30 **Die Castings**—Dollin Corp.—16-page facilities brochure—shows their techniques for zinc and aluminum die castings with rigid design requirements.

31 **Metal Working Lubricants**—Fiske Brothers Refining Co.—Technical bulletins—on hot die and other specialty lubricants.

32 **Tool & Die**—Gentry Carbide Tool & Die Co.—6-page brochure—shows their equipment for making carbide tools and dies.

34 **Plaster Mold Castings**—Gorham Electronics—Brochure—describes their engineering and manufacturing facilities for plaster mold cast electronic components.

35 **Extrusion Die Lubricant**—Grafo Colloids Corp.—Booklet—describes colloidal graphite lubricants for high temperature and pressure applications.

36 **Tiny Zinc Die Castings**—Gries Reproducer Corp.—Booklet—includes designer's check list for small zinc die castings.

37 **Zinc Alloys**—Henning Bros. & Smith—Reference book—and guide to the selection of zinc base die casting alloys.

39 **Investment Casting**—Hitchiner Mfg. Co.—13-page booklet—explains the ceramic shell investment casting process and shows Hitchiner's facilities.

41 **Fire Resistant Fluids**—E. F. Houghton & Co.—Bulletin—describes hydraulic fluids which provide both fire and wear protection.

42 **Die Casting Machines**—Hydraulic Press Mfg. Co.—Catalog—describes hot and cold chamber die casting machines from 100 to 2000 ton capacities.

44 **Impact Extrusions**—Impact Extrusion Products, Inc.—Brochure—tells how to use the impact extrusion process to cut costs.

47 **Impact Extrusions**—Janney Cylinder Co.—Brochure—describes their facilities for impact extruding.

48 **Investment**—Kerr Mfg. Co.—Catalog describes Duracast, a non-ferrous investment, and other industrial products.

49 **Die Casting Machines**—Kux Machine Co.—Catalog—describes a complete line of die casting machines.

51 **Extrusion Tool Steels**—Latrobe Steel Co.—Technical data—on a complete line of extrusion tool steels.

52 **Induction Heating**—Lepel High Frequency Laboratories, Inc.—Catalog—describes high frequency induction heating equipment.

55 **Sinterings**—Merriman Bros., Inc.—Technical bulletin—and catalog on highest quality, dimensionally accurate sinterings.

56 **Laboratory Services**—Metal Control Laboratories—18-page booklet—describes metallurgical and laboratory services available.

57 **Extrusions**—Midwest Aluminum Corp.—Brochure—describes extrusion services from design to finished product.

60 **Machining Table**—Morrison Machinery & Engineering Corp.—Bulletin—describes a cross slide rotary table used for all milling machine operations with one setup.

64 **Sinterings**—New Jersey Zinc Co.—Technical manual—tells how to design for pressed brass and nickel silver metal powder parts.

65 **Vacuum Furnace**—New York Air Brake Co.—Literature—on high vacuum furnaces, pumps, and gages.

66 **Extrusions**—North American Extrusions Corp.—Brochure—shows their facilities for fabricating and anodizing extrusions.

67 **Mold Lubrication**—Pierce Waller Inc.—Data sheet—on the Air-Lube system for cleaning and lubricating mold surfaces.

68 **Extrusions**—Precision Extrusions, Inc.—Brochure—gives detailed studies on how aluminum extrusions cut costs.

70 **Sinterings**—Reese Metal Products Corp—16-page booklet—tells how to cut precision parts costs with Remet powdered metal process.

72 **Low-Hydrogen Nickel**—Sherritt Gordon Mines Ltd.—Brochure—gives prices and delivery information on Sherritt nickel and cobalt.

75 **Ladles**—Spincraft, Inc.—Data and prices—on stainless steel ladles of non-spill design which are 75% lighter than cast iron models.

more data on page 130

76 Impact Extrusions—Steel Industries, Inc.—Manual—tells how to design impact extrusions.

79 Extrusion Equipment—Sutton Engineering Co.—Bulletin—describes a full line of high-speed production extruding equipment.

80 Brass Die Castings—Titan Metal Mfg. Co.—Brochure—discusses the use of pressure brass die castings for cored parts with thin sections.

82 Tool Steel—U.N. Alloy Steel Corp.—Catalog—describes a complete line of hot work tool steel.

86 Extrusions—R. D. Werner Co., Inc.—Handbook—tells how to cut production costs by using aluminum extrusions.

87 Burnishing Media—The Abbott Ball Co.—Bulletin—tells how their burnishing media produces a gleaming, long-lasting, polished surface.

88 Corrosion Protection—Allied Research Products, Inc.—Technical manuals—describe chromate conversion coatings and clear protective coatings.

89 Metal Preservative—Enthone, Inc.—Technical data—on a new series of rinse water additives which give metal surfaces a protective coating.

90 Painting Equipment—Conforming Matrix Corp.—Bulletin—describes electroformed masks, automatic painting machines, part and mask fixtures, and mask washers.

91 Barrel Finishing Media—Minnesota Mining & Mfg. Co.—Booklet—"There's gold in Them Thar Barrels" describes Honite barrel finishing media.

99 Sinterings—Mueller Brass Co.—Information—on their facilities for making sinterings, impact extrusions, and other parts.

101 Laboratory Furnace—Hevi-Duty Electric Co.—Bulletin—describes a laboratory crucible furnace which provides precise melting control.

102 Dry-Hearth Furnace—Hevi-Duty Electric Co.—Bulletin—describes a double chamber, dry-hearth furnace.

103 Reverberatory Furnaces—Hevi-Duty Electric Co.—Bulletin—describes reverberatory furnaces which provide ±10°F. control.

104 Plaster Mold Castings—Atlantic Casting & Engineering Corp.—Complete information—on how larger aluminum castings with close tolerances are economically produced by precision casting methods.

105 Crucible Melting—Crucible Manufacturer Assn.—Brochure—tells how to get the most from your crucible melting.

106 Melting Furnace—International Foundry Supply Co.—20-page brochure—tells how and why the Revecon Furnace is right for your operation.

110 Powder Metallurgy Equipment—General Machine Co. of N.J.—Catalog—describes equipment for blending, vacuum drying, and handling powdered metals.

111 Die Casting Machines—American Die Casting Machinery Co.—Catalog—describes their rugged, low-priced, die casting machines.

113 Die Casting Dies—Crucible Steel Co. of America—Technical data—on CMS 2 steel which eliminates the heat treatment of most zinc die casting dies because of its uniform hardness.

115 Die Casting Machines—Eric P. Cahn—Bulletin—describes a line of die casting machines of from 75 to 1200 tons capacity.

116 High Temperature Alloy—Cannon Muskegon Corp.—Technical Bulletin—gives data on an alloy for use in the 1200°-1800°F. range.

117 Investment Castings—Investment Casting Co.—Brochure—shows how you can save time and money by using investment castings.

119 Cut-Off Saw—Oliver Machinery Co.—Folder—gives details on an extrusion cut-off saw.

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Electrolytically refined TADANAC Brand Special High Grade Zinc, is a high quality product that means efficient, trouble-free performance from your casting units. With TADANAC Brand you can be sure of uniform quality, reliable supply and prompt delivery. Further assistance is readily available from our Technical Service Staff, who are fully conversant with the zinc die-casting industry. For your convenience TADANAC Brand Special High Grade slabs have just been re-designed to travel better and handle easier.

When you order zinc specify TADANAC Brand.

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Toronto WORLD'S LARGEST LEAD-ZINC PRODUCER Montreal

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Whether furnace output is measured in grams or tons, Hevi-Duty's value solution pays steady operating dividends.

When you consult a Hevi-Duty Sales Engineer on any heat-processing problem, you take three important steps toward a sound solution. For Hevi-Duty helps you three ways:

Designs the system to fit your need. A Hevi-Duty Applications Engineer works full time on such problems. Call on him. He might save you countless hours. He may have solved a problem like yours last week.

Designs the furnace to fit the system. Usually, the unit you need will be a proven item, for you are drawing from the most complete line of heat-processing equipment in the business. If not, Hevi-Duty engineers can quickly design the unit that fits your needs exactly.

Builds the furnace to last. Hevi-Duty furnaces are built for tough, continuous production work. They are designed to last, and hundreds of case histories prove they do.

Here are three typical examples of non-ferrous melting furnaces spanning a wide range of sizes, yet each provides the value solution to a problem.

HEVI-DUTY

Electric and Fuel-Fired Industrial Furnaces and Ovens

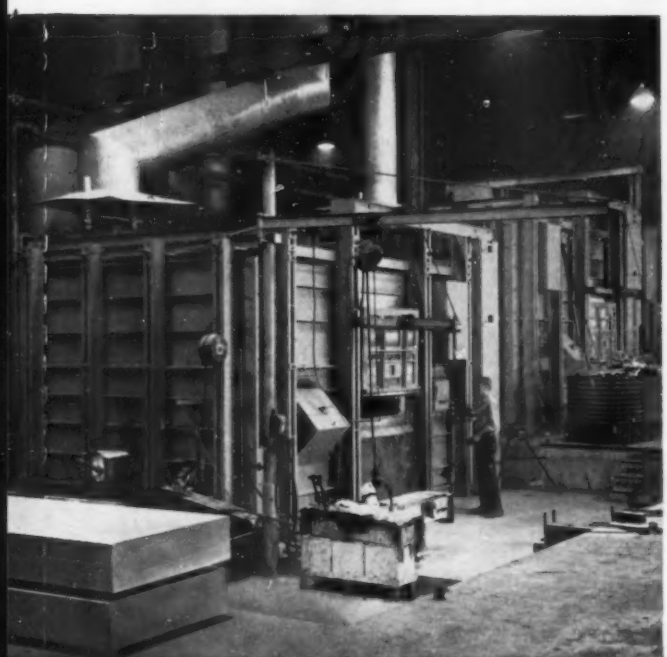
B P C

A Division of Basic Products Corporation

Hevi-Duty Electric Company, Milwaukee 1, Wis.

Wall Colmonoy Corp., Detroit, Michigan, uses this Hevi-Duty laboratory crucible furnace to find exact melting temperatures of hard-surfacing and brazing alloys. Furnace heats rapidly to the 2200° F. temperature required, provides precise control for melting and cooling tests on 250 g samples. User reports long element life at high temperatures. ***For more information, send for Bulletin 1246.***

This Hevi-Duty double-chamber, dry-hearth furnace melts 100 lb of aluminum per hour, 16 hours a day, 7 days a week at Alliance Mfg. Co., Alliance, Ohio. It can provide up to 200-lb-per-hour output and occupies little space. It maintains critical bath temperatures during charging. User states: "You can turn it on and forget about it." ***For complete information, send for Bulletin 593.***



Kawneer Company, St. Charles, Illinois, has installed a second pair of Hevi-Duty reverberatory furnaces for breakdown and holding in direct-chill ingot casting of four different alloys. Furnaces provide ± 10° F. control, pour at 1320° F., operate 24 hours a day. Capacity is 100,000 lb a day. Note in the foreground two of the 6,300-lb aluminum ingots produced. ***Please write for Bulletin 591.***

M.P.I.F. ELECTS MAGNETIC METALS

The Metal Powder Industries Federation announces the election of Magnetic Metals Company to corporate membership in the Metal Powder Core Association.

Magnetic Metals Co. located in Camden, New Jersey, is a manufacturer of molybdenum permalloy cores used in electronics and made by powder metallurgy techniques.

Representing the company in the Association is D. O. Schwennesen, Vice President.

BUYS AUTHENTICAST LINE

The "Authenticast" line of Comet Metal Products has been purchased by Industrial Models, Inc. The new company "Authenticast Ltd." will be an independently operated affiliate with its manufacturing activity located in Queens, New York.

Robert F. Engler, formerly manager of Industrial Models, Inc., Cleveland plant, will operate "Authenticast Ltd." as Vice President and General Manager. "Authenticast Ltd." will continue to manufacture and distribute the famous "Authenticast" line of detailed lead alloy toys.

stop costly parts machining

Machining metal chips costs you money. Why be a prime supplier to the scrap metal market?

Let us investment cast your alloy part. Usually, no machining at all is required—or at most, only minor finishing.

Sound interesting? A sketch and specs on the part you need are about all we need for prototype or production runs. Shell-mold and vacuum casting also available. Contact us at Westinghouse Electric Corporation, Metals Plant, Blairsville, Pa.

J-05013

Extensive savings on machining were realized on this magnetic clutch with Westinghouse investment casting.

You can be sure . . . if it's

Westinghouse

Circle No. 85 on Reader Service Card

NEW DOW PROCESS

Photomicrograph (250X) of magnesium casting (AZ63A alloy) shows Dow 17 anodize impregnating pores (arrows) and surface of casting. Black area is plastic mounting compound.

A process that combines impregnation and paint-base coating of magnesium-alloy castings in a single operation has been developed by The Dow Metal Products Company, Division of The Dow Chemical Company.

Dow said the new process is a modification of the standard Dow 17 anodize treatment. Regular Dow 17 procedure provides a paint base but does not seal all of the porous areas of castings. The modification consists of allowing a dwell or current "dribble" of 20 to 30 minutes constant voltage at the end of the normal anodization period.

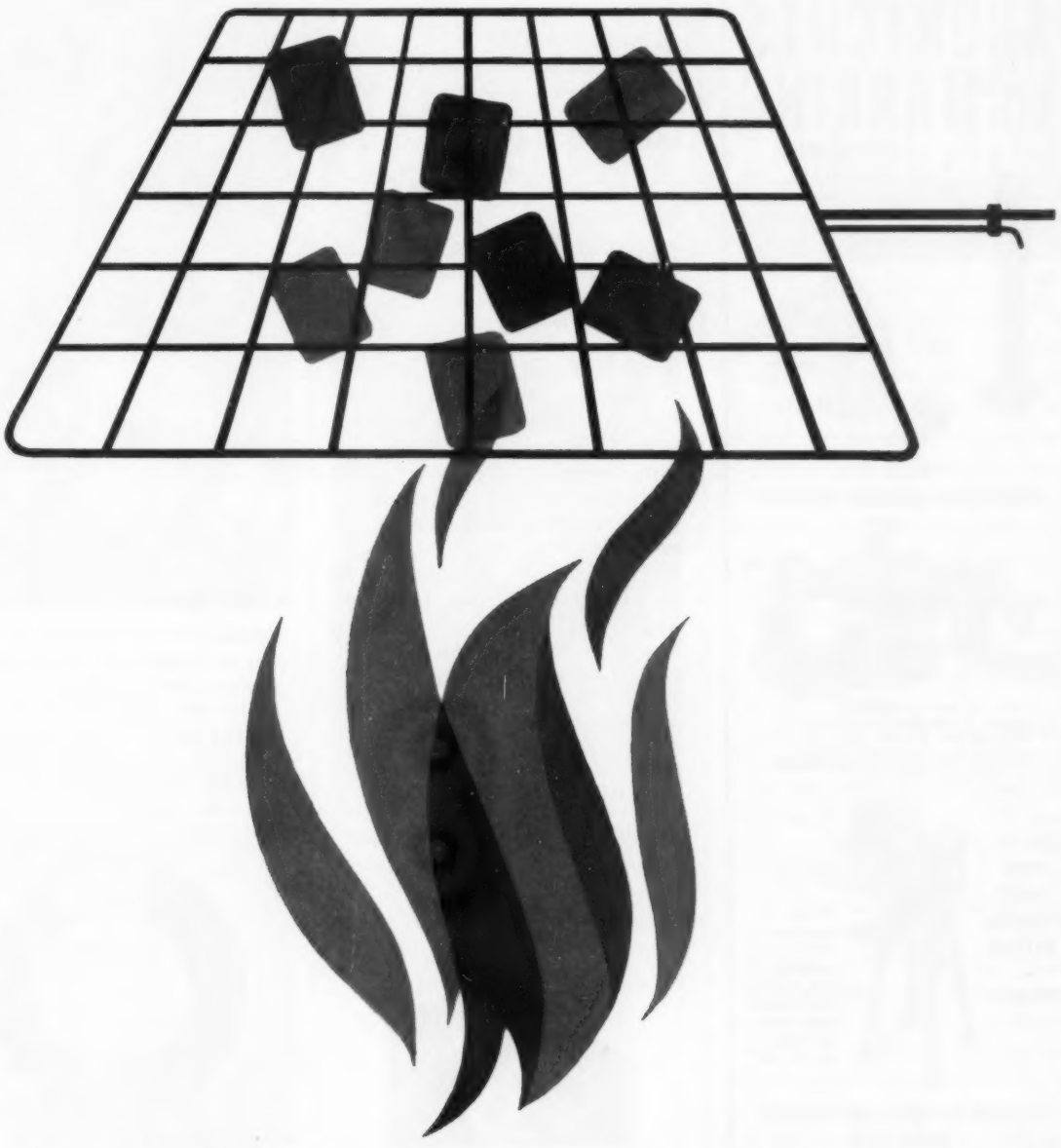
During the dwell, anodization continues primarily in the pores of the casting, sealing even minute pores effectively, Dow said.

HUMPHREY APPOINTED

HUMPHREY

Robert L. Humphrey has been appointed Sales Representative by Alloys & Chemicals Corporation as announced by the firm's President, Noah L. Butkin. Humphrey is a graduate of Boston University and was associated with Kaiser Aluminum & Chemical Sales, Inc., since his graduation in 1950.

more industry news on page 134



toasted nickel briquettes for low H_2 diet

Sherritt's recipe for making low-hydrogen nickel is as effective as it is simple: take pure nickel powder, press into uniform briquettes, and heat for a quarter of an hour at 1650°F. The result: pure nickel in its handiest form, with scarcely a trace of hydrogen. High-purity Sherritt nickel is also available in three standard grades of powder, special grades, and coated powders.

FOOTE MINERAL COMPANY *is the exclusive sales agent for Sherritt nickel and cobalt in the United States and Canada. For complete illustrated brochure with prices and delivery information, contact the Foote Mineral Company, 474S Eighteen West Chelten Building, Philadelphia 44, Pa.*

SHERRITT GORDON MINES LIMITED

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SHORTCUTS to MARKING

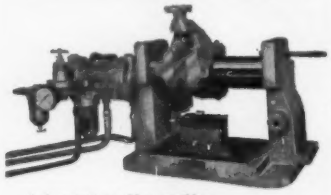
ACROMARKER NAME-PLATE STAMPING MACHINES

40 Characters all interchangeable. Standard sizes range from 1/16" to 3/8". Write for Color Folder.

No. 1F

No. 1

Model 9 PNEUMATIC MARKING MACHINE



A low cost marking machine powered by your regular air line 75 psi. and over. It marks parts, tools, sleeves, etc. of steel and also marks plastic with slight additional assembly. Write for Catalog No. 9.

No. 2A NAME PLATE STAMPING MACHINE • Automatic •

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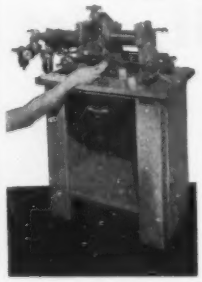
PERIPHERAL MARKING MACHINE Model 9AH



Marks precision calibrations and graduations around dials. Uses flat dies to mark round and roll dies to mark flats. A high production machine that will not break even brittle plastic parts. Write for Catalog. No. 9AH.

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INDUSTRY NEWS *continued*

M.P.I.F. HONORS PAST PRESIDENTS

Seven past presidents of the Metal Powder Industries Federation were honored by the members of that organization at a banquet in the Mount Washington Hotel, Bretton Woods, New Hampshire, on September 17th.

The banquet was the highlight feature of the Federation's Fall Business Meeting and Management Conference attended by some 150 of the industry's management.

The current President, Dr. George A. Roberts, Vice-President of the Vanadium-Alloys Steel Company, presented engraved plaques to: Harold E. Hall (posthumously) Metals Disintegrating Co.; Biderman T. du Pont, Crane Co., Metals Div.; Thomas L. Robinson, Powdercraft Corp.; Ernest H. Klein, New Jersey Zinc Co.; Thomas H. Moore, Antara Chemicals Div., GAF; Paul E. Weingart, American Metal Climax, Inc.; and Morris Boorky, Presmet Corp.

ESTABLISH DETROIT OFFICE

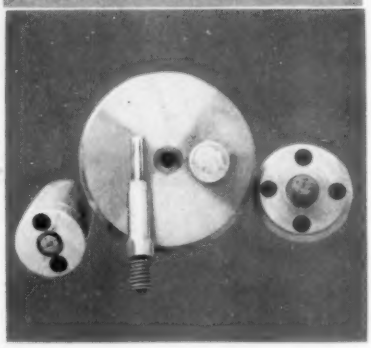
B. LADENDORF

Establishment of a new engineering, sales and service office in Detroit, was announced by Precision Extrusions, Inc., Bensenville, Illinois, designer and manufacturer of extruded aluminum.

This new district office will serve Michigan and Northern Ohio, according to James E. Hill, Precision Sales Manager. Appointed to head this new sales and service headquarters is Bernard C. Ladendorf and a twin brother, Jack Ladendorf. Both men have had more than 15 years experience in sales.

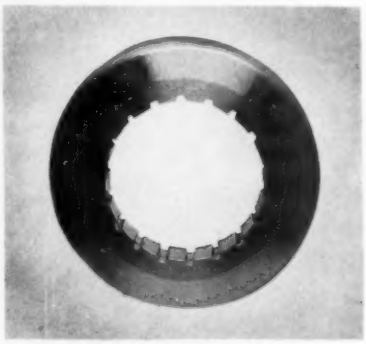
more industry news on page 136

From MINIATURE PRECISION SETS up to industry's present COMPACTING LIMITS



MINIATURE DIE above is one example of Gentry's modern manufacturing methods. Simple-to-intricate forms and shapes made to your specifications.

LARGE DIE below shows what modern compacting dies we make, either by visual grind or Elektrojet.



THIS COMBINATION

of engineering know-how and the latest equipment guarantee the highest quality carbide tools. We service our dies and give you prompt delivery.

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CARBIDE TOOL & DIE CO., INC.

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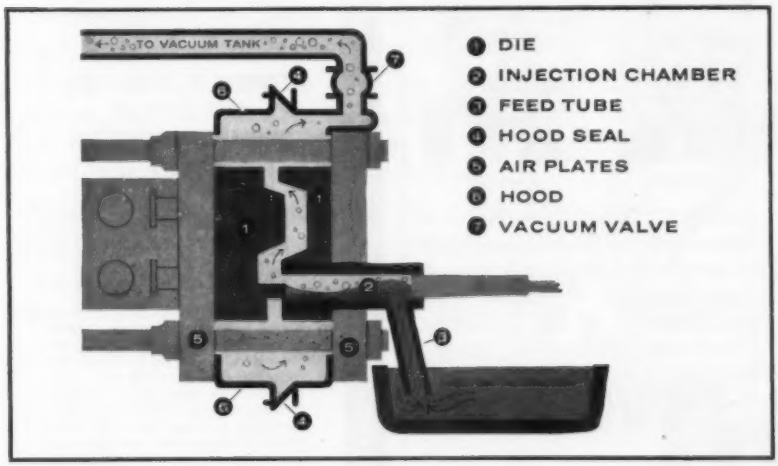
REED-PRENTICE
DIE CASTING NEWSLETTER

a look at vacuum die casting, its use and importance.

Vacuum die casting of aluminum offers as much promise for product design as vacuum die casting of zinc has in the past few years. Major improvements such as cleaner, lighter castings from a new spectrum of aluminum alloys make possible the use of new finishing operations as applied to die casting. In general, greater liberties can be taken with part design. Compositions that can be anodized, heat treated or brazed can now be successfully die cast. Improved tensile strength and uniformity make thinner walls and less support-metal practical.

REED-PRENTICE has developed an automatic vacuum feed system that successfully combines vacuum die casting of aluminum with automatic ladling. This VACUFEED system, as the diagram shows, first transfers the aluminum from the furnace to the injection chamber in a fully enclosed passage maintained at pouring temperature. This protects the metal from oxidation and temperature fluctuation. Second, the molten metal is drawn from below the surface of the melt. There is no inclusion of the surface dross to impair the properties of the die casting. And third, each shot of molten aluminum is accurately metered.



The field for vacuum die cast aluminum parts is broad and growing—from thin, colorful, automotive trim strips and grill decorations to small watch cases, appliance parts and electronic components. REED-PRENTICE VACUFEED enables engineers to specify vacuum cast aluminum parts—with all the inherent die casting advantages—for designs and compositions never before considered. REED-PRENTICE engineering has pioneered to find the best way to die cast aluminum with a vacuum. The advantages are many, the savings greater and, most important, the complete equipment is manufactured by REED-PRENTICE. Complete details on the techniques of VACUFEED die casting is as close to you as your nearest REED-PRENTICE Sales Engineer. Call him today.

REED-PRENTICE

.....division of

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BRANCH OFFICES: NEW YORK • CHICAGO • BUFFALO • CLEVELAND • DEARBORN • KANSAS CITY • LOS ANGELES

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WORKHORSE

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is a Non-Ferrous investment specifically formulated to give:

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For Ferrous Metals
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INDUSTRY NEWS *continued*

LATROBE NAMES WANDRISCO

WANDRISCO

Latrobe Steel Company has announced the promotion of John Wandrisco, Assistant to the President, to Vice President in charge of Corporate Planning.

A graduate of Massachusetts Institute of Technology and the Harvard Graduate School of Business, Wandrisco joined Latrobe Steel in 1951 as Assistant to the Vice President in charge of Sales, later serving as General Manager of the Special Products Division and Manager of Marketing before moving to the President's office.

KENDALL APPOINTED

KENDALL

DWYER

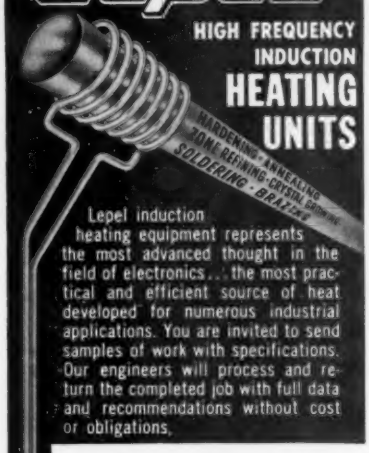
Charles E. Kendall, formerly a vice-president of The Connecticut Bank and Trust Company, has been named president, treasurer and general manager of the Connecticut Investment Casting Corp., Stonington, Conn. Former president Patrick J. Dwyer has become chairman of the board.

VANADIUM-ALLOYS TO USE SHAW PROCESS

Vanadium-Alloys Steel Company has announced the completion of a licensing agreement with Shaw Process Development Corporation covering the use of the Shaw Process for precision castings.

more industry news on page 138

LepeL



HIGH FREQUENCY INDUCTION HEATING UNITS

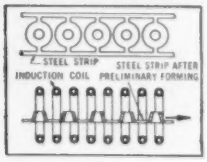
Lepel induction heating equipment represents the most advanced thought in the field of electronics . . . the most practical and efficient source of heat developed for numerous industrial applications. You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations.

TYPICAL INDUCTION HEATING APPLICATIONS

PLASTIC COATING OF TOOL HANDLES

A production line operation for coating handles of tools at Whitney Metal Tool Co., Rockford, Ill. uses induction heating with excellent results. The handles only are heated by induction to the desired temperature then dipped into a vinyl chloride base coating material for a short period depending upon the thickness of coating desired. The plastic coating formed on the handles is then cured by immersion in a carbo-wax bath.

FORMING OF METAL STRIP FACILITATED BY PROGRESSIVE ANNEALING



Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

WRITE FOR NEW LEPEL CATALOG
Electronic Tube Generators from 1 Kw to 100 Kw.
Spark Gap Converters from 2 Kw to 30 Kw.

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Use **BRASS** Die Castings for intricate cored parts with thin sections

Here's why! You need little or no secondary machining on Titan brass pressure die castings. Look for intricate shapes and deep cored holes in your component parts and you'll spot a Titan die casting, *or the need for one.* Tough assignments such as thin metal sections and complicated shapes are standard custom when designed as a Titan brass pressure die casting.

To save weight, wall sections as thin as .070 inches are possible. Even 1/32-inch section is accomplished by Titan craftsmen if the section area is right.

Compare with sand castings and other metal forms you now use. You'll discover the sharper outlines, dimensional accuracy, higher strength and fine grain structure of Titan brass pressure die castings.

Titan design specialists will work with you to make your product better with the proper brass die-cast part.

May we say more? Call your nearest Titan Office for detailed information and a brass die casting quote.

45 Years of Quality Brass

Send for latest folder on Titan pressure die castings. Write us on your letterhead.

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METAL MANUFACTURING COMPANY
DIVISION OF CERRO DE PASCO CORPORATION
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FREE POWDERED METAL PARTS BOOKLET SHOWS . . .

colorful, newly revised 16-page booklet illustrates and describes:

- the powdered metal process . . . what it is and does
- gives limitations and advantages of the powdered metal process
- shows design DO's and DON'T's for powdered metal parts
- provides physical characteristics chart of standard Remet materials
- plus specific application stories

Send for your copy of this helpful booklet today!

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Gears • Pinions • Cams • Ratchets "Oilless" Bearings • Bushings • Machine and Structural Parts in COPPER • BRASS • IRON • ALLOY STEEL • NICKEL SILVER • COPPER INFILTRATED IRON

never too hot to handle!

Spincraft
SKILL WILL DO IT

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Stainless steel construction and special reinforcing at bottom and pouring edge means much longer life.

NON SPILL SHAPE ELIMINATES WASTE!

75% LIGHTER THAN CAST IRON LADLES!

Available in all sizes, stainless and mild steel.

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HERRON APPOINTED DIVISION MANAGER

HERRON

K. "Red" Herron has been appointed Eastern Division Sales Manager by the Alloys & Chemicals Corporation, Cleveland, Ohio, it was announced by N. L. Butkin, Alloys & Chemicals Corporation President. In his new capacity he will be responsible to the President for all A & C aluminum alloy and deoxidizing aluminum sales and service to sand, permanent mold, and die cast foundry and steel mill installations in the Eastern Division. This encompasses the Cleveland, Pittsburgh, New York, and Indianapolis Sales Districts.

VANADIUM-ALLOYS APPOINTS KALB

KALB

Vanadium-Alloys Steel Company has named E. W. Kalb to the position of Manager of Market Development. Kalb's duties will be concerned with the promotion of new steel grades and the development of new steel markets. He is a graduate of the University of Illinois with a Bachelor of Science degree in Chemical Engineering.

more industry news on page 140

Circle No. 54 on Reader Service Card

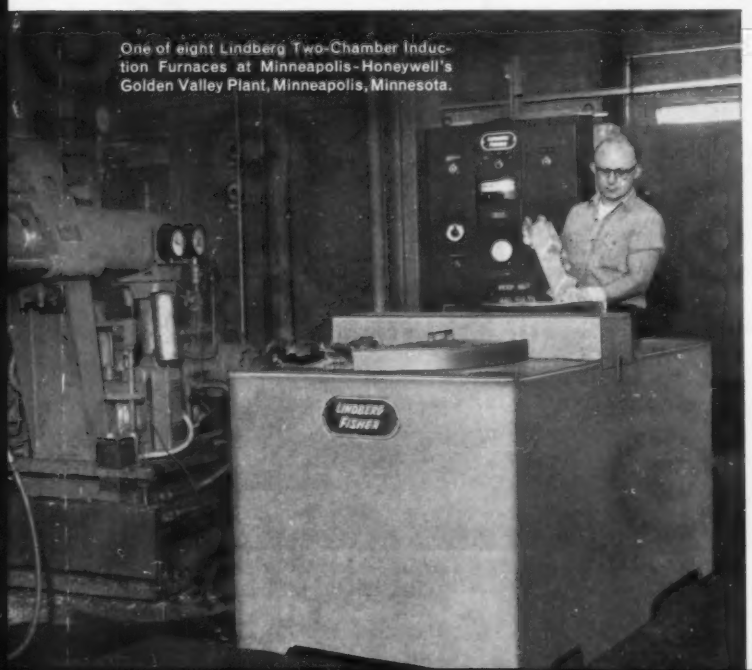
ART GEORGE has a good word to say for Lindberg Melting Furnace performance

QUOTE

Mr. Art George, Senior Production Engineer, Golden Valley Plant, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

"Our installation of eight* Lindberg-Fisher Two-Chamber Induction Melting and Holding Furnaces has given remarkable service for more than four years. In this period, with the help of a well executed Honeywell maintenance program, the installation has been unusually trouble-free. Only one of the eight furnaces has required relining over this long period. Handling more than 1,000,000 pounds of aluminum and zinc annually, the installation has unfailingly provided the consistently high quality of metal our precision instruments require."

**Altogether, 44 Lindberg Furnaces are in operation in various Honeywell plants.*



One of eight Lindberg Two-Chamber Induction Furnaces at Minneapolis-Honeywell's Golden Valley Plant, Minneapolis, Minnesota.

These eight Lindberg-Fisher Induction Furnaces melt and hold aluminum and zinc for die casting gas valve housings and other component parts. They are located at the die casting machines where ingot and scrap can be melted and held at the desired casting temperature in one convenient unit. Magnetic fluxing and stirring insures uniform temperatures and consistently clean metal.

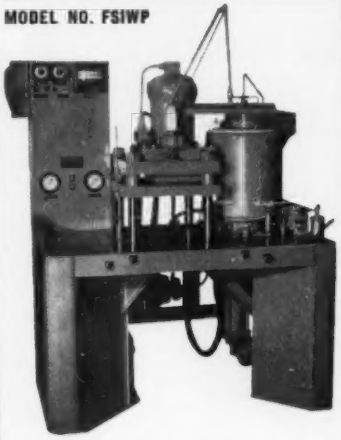
In any production process where aluminum needs heat there is Lindberg equipment to apply it most economically and efficiently. Furnaces for melting and holding, casting stations, re-melting or heat treating are available in all capacities, electric or fuel fired. Get in touch with your Lindberg Field Engineer (see your classified phone book) or write us direct. Lindberg-Fisher Division, Lindberg Engineering Company, 2463 West Hubbard St., Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, South Africa, Spain, Switzerland and West Germany.

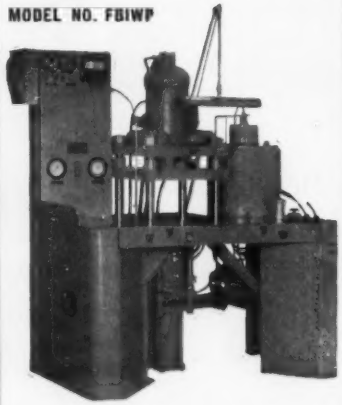
LINDBERG
heat for industry

NEW
3½ lbs. WAX CAPACITY ON STANDARD MODEL #FSIWP

MODEL NO. FSIWP



MODEL NO. FBIWP



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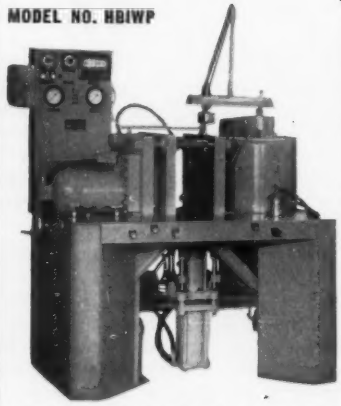

For complete details write direct to Leyden Hydraulics

Any Type or Size Unit Built to Your Specifications.

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1800 North River Rd. • Melrose Park, Ill.

INDUSTRY NEWS *continued*

OPIE NAMED MANAGER OF RESEARCH

Dr. William R. Opie has joined American Metal Climax, Inc. as manager of research at the Carteret, New Jersey laboratory of its subsidiary company, Amco Research & Development, Inc. In his new position, Dr. Opie will direct all AMAX copper, lead and zinc research.

Prior to joining American Metal Climax, Inc., Dr. Opie was employed by the Titanium Division of National Lead Company at South Amboy, New Jersey as the research supervisor of the Geochem and Metallurgical Department. He also has been engaged in research capacities by American Smelting & Refining Company, Massachusetts Institute of Technology and Wright Aeronautical Company.

Dr. Opie received his B.S. in Metallurgy from Montana State University in 1942 and his Ph.D. from MIT in 1948.

AMPCO NAMES LICENSEE FOUNDRY

Arwood Corporation, New York, has been appointed a licensee foundry by Ampco Metal, Inc., Milwaukee. As an Ampco licensee, Arwood will produce investment castings from ingots of special copper-base alloys made by the Milwaukee firm under its trademarks AMPCO metal and AMPCOLOY. With Arwood's appointment, 18 foundries in the United States and Canada are now licensed to cast Ampco metal.

AMPCO NAMES BYBEE

John K. Bybee will represent Ampco Metal, Inc. as an agent in the Southeastern United States, according to J. P. Henry, Ampco Vice President and General Sales Manager.

The appointment expands Ampco's representation into Georgia, North and South Carolina, Florida and Tennessee. The new agency is located in Decatur, Georgia.

Bybee has been associated with the firm since 1939.

Be sure to see us at the **Metals Show — Booth 1211**

GRC tiny die castings made in one fast automatic operation ...simple or intricate parts, high in quality, low in cost

Gries' exclusive patented methods make possible wide design latitude . . . assure uniformity, accuracy and smooth surfaces on small parts of all types . . . for a wide variety of uses . . . at substantial savings. GRC die castings leave the machines trimmed, ready for use. In addition GRC's unique single cavity die casting techniques offer new shortcuts in assembly . . . new approaches in product design through our exclusive methods.

tiny zinc die castings

NO SIZE TOO SMALL! Maximum sizes up to 1¾", ½ oz.

Write for samples, prices & fact-filled booklet "Small Zinc Alloy Die Castings." Includes helpful designer's check list.

25 years of progress in tiny parts

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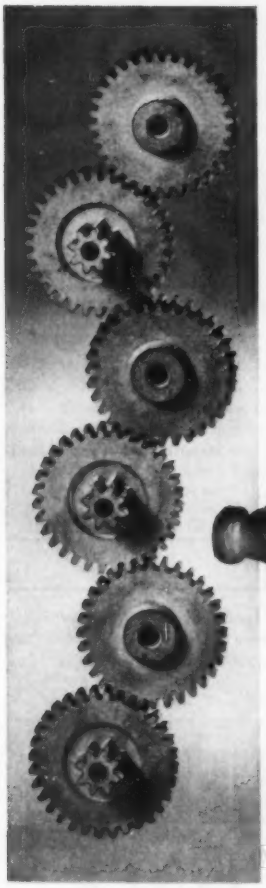
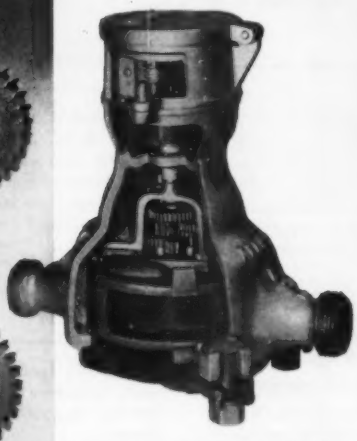
BRONZE POWDER for GEARS that FIT THE JOB





CONTROL OF OUR DIMINISHING WATER SUPPLY DEMANDS EFFICIENT METERS IN GREATER NUMBER WITH FEWER AND BETTER OPERATING PARTS

Matching metal powder gears, supplied by a custom fabricator* ready for assembly, provide this ROCKWELL water meter gear train with friction-free operation, low parts cost, precision and durability.

Nonferrous powder metallurgy can produce accurate, low-cost components for your products as well.

*The PRESMET Corp., Worcester, Mass.

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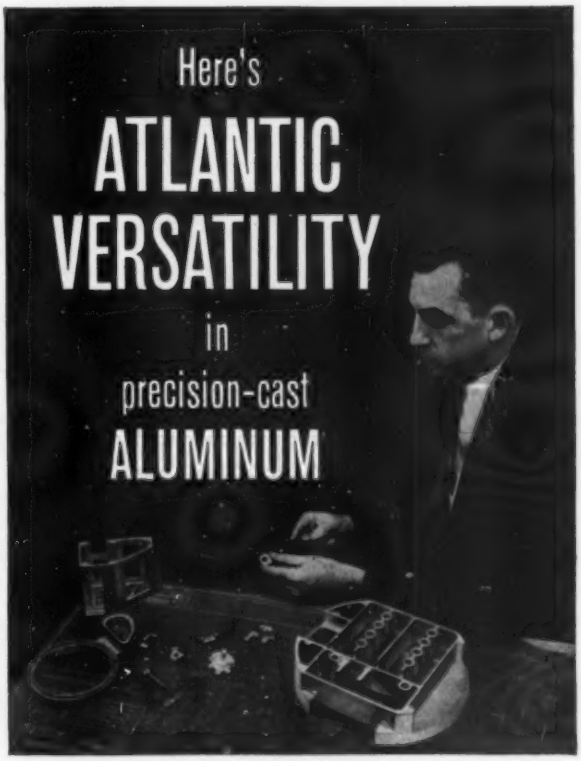

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Tooling costs will average 20 to 25% that of comparable die castings.

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jobs & equipment

Opportunities rates: $20 for the first column-inch; $15 for each additional column-inch payable in advance. To answer box number advertisements, address responses to the box at Precision Metal Molding, 812 Huron Road, Cleveland 15, Ohio. Closing date: 1st day of month preceding publication.

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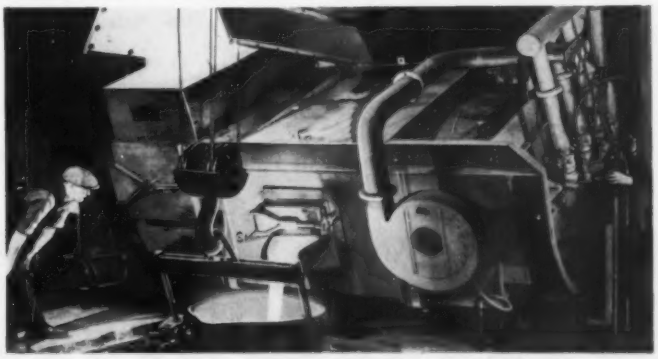

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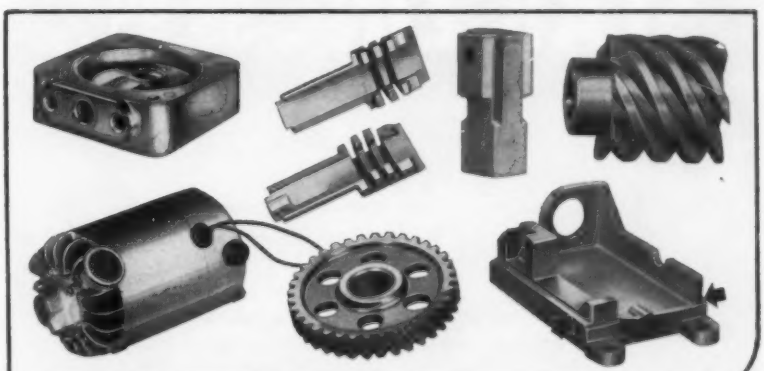

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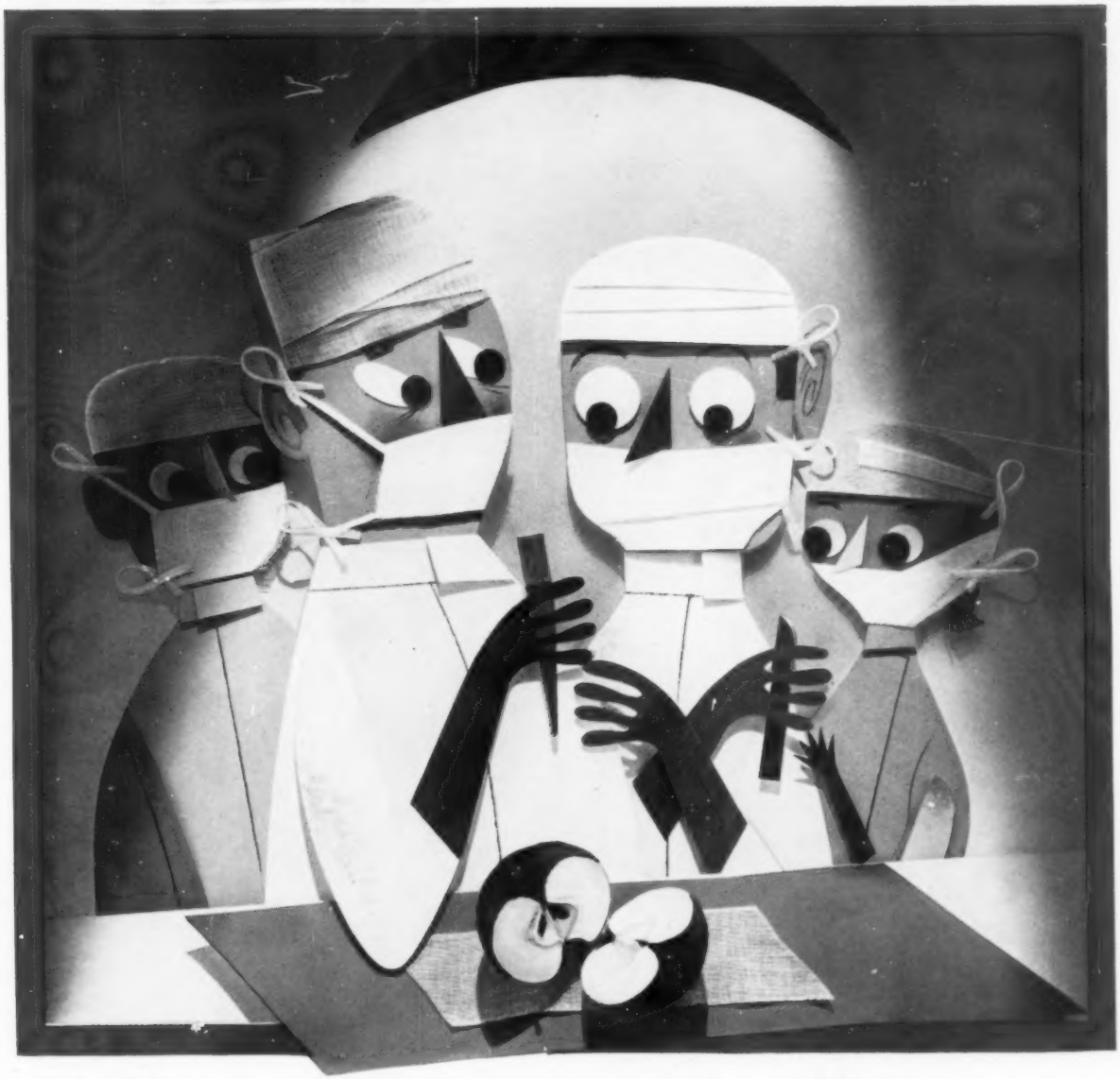

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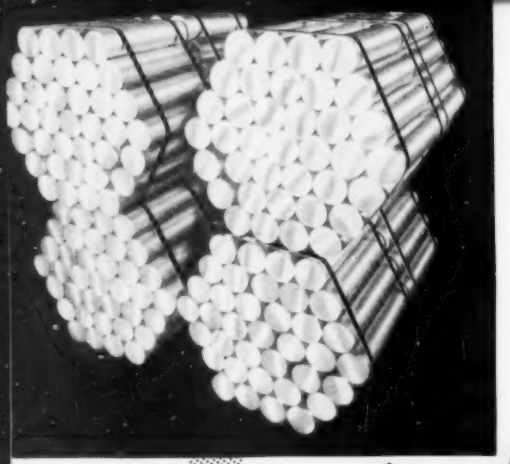

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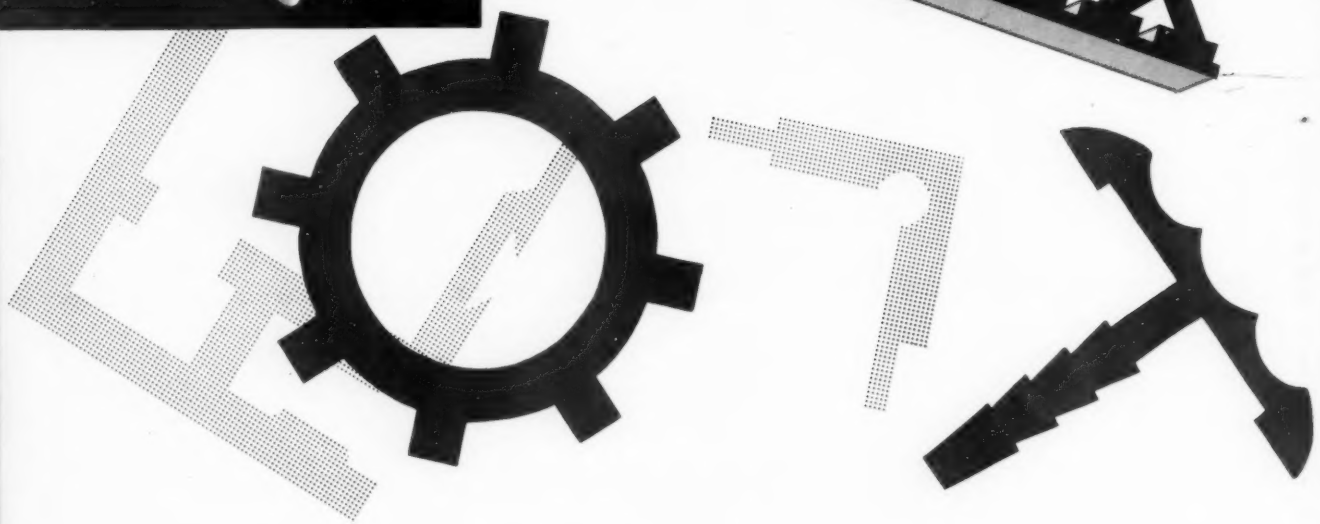

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